SCIENTIFIC AMERICAN

Copyright by Brown & Dawson

Unexploded 42 centimeter shell lodged in the iron roof beams of a vault. Note the spiral scoring on the shell and the twisted roof plates; also the 7 centimeter shell held up for comparison.

THE RECAPTURE OF PRZEMYSL—[See page 251.]

Vol. CXIII. No. 12
September 18, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, SEPTEMBER 18, 1915

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary; Orson D. Munn, Treasurer; all at 233 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter

Entered as Second Class Matter at the Post Office Department, Canada.

Subscription Rates

Subscription one year	$3.00
Postage prepaid in United States and possessions, Mexico, Cuba, and Panama.	
Subscriptions for Foreign Countries, one year, postage prepaid.	4.50
Subscriptions for Canada, one year, postage prepaid	3.75

The Scientific American Publications

Scientific American (established 1845) per year	$3.00
Scientific American Supplement (established 1876) " "	5.00

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.

Remit by postal or express money order, bank draft or check.

Munn & Co., Inc., 233 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contribution will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The War and Immigration: An Unintentional Experiment in Restriction

FOR years the restrictionists have sought to have a law placed on the statute books which would cut down immigration. What they have been unable to accomplish themselves, the war has done for them. In the years 1913 and 1914 the totals of aliens admitted to the United States were 1,427,227 and 1,403,081, respectively, and the gains in alien population, after deducting the numbers of those who returned to Europe or elsewhere, were 815,303 and 760,276. The increase in alien population in the course of the immigration year which ended June 30th was 50,070. The number of aliens who were admitted was 434,244, while the number who left was 384,174. The most drastic restrictive legislation could not have cut down the flow as the war has done.

Not only has the war fulfilled the desires of the restrictionists in respect to a wholesale reduction in numbers, but also in respect to the racial character of the immigrants. The restrictionists have argued that those from central and southern Europe were undesirable because they were not closely allied in blood with the original settlers of the country, and because their political institutions and social habits were different. One of the results of the war has been that the majority in 1914-1915 came from the countries fronting on the North Sea and the Atlantic Ocean. Of the large number who went home, in many cases to join the colors of their respective countries, by far the larger proportion were of the class of so-called undesirable nationalities.

The period of reduced immigration is likely to continue more than a year, and the indications are that it may last for three or four years. It is not generally believed that peace will be concluded within a year. Following the war there will be much constructive work to be done in all parts of Europe. It can be said with confidence that the countries now at war, or which become involved, will not encourage emigration. Some of them, on the other hand, will do what they can to discourage it. This will be particularly true of lands where industry has been built up on a considerable scale. Some governments will not, of course, be in so good a position to interfere as others, owing to the freedom of movement guaranteed by the laws or customs. Fighting for the salvation of the Fatherland stimulates patriotic feeling. Doubtless this will play some part in retarding emigration.

It is evident, also, that the war is rapidly depleting the ranks of those who emigrate. These are the men under forty-five years of age. The stupendous casualty lists suggest that there will be many in this class who, because of physical or mental disabilities, will be unable to meet the requirements of our immigration law regarding capacity to earn a livelihood, and mental soundness.

With a much smaller immigration we shall have an opportunity to study the social and economic effects of restriction without committing ourselves to the policy. We have knowledge based on experience of the results of a large immigration. By permitting proposed legislation to lie upon the table for a while we shall be enabled to decide upon our future policy with greater knowledge at our command.

The Diabetic Triad

AMONG the several scientific theories as to the nature of diabetes or "sugar sickness," three have peculiar weight; these have reference to the pancreas, the liver, and the nervous system.

It is part of the business of the pancreas to furnish ferments for the digestion of the carbohydrates (the starches and the sugars) one eats; these foodstuffs are thus converted into glucose, which is then conveyed, by the portal vein, to the liver; and thence to the general circulation. The muscular and other active tissues then normally burn up this glucose, heat and energy being the product. Dr. Samuel J. Meltzer of the Rockefeller Institute and his associate, Dr. I. S. Kleiner, recently set forth before the Association of American Physicians at Washington the results of two years of research and experimentation, during which they found that when dextrose (a form of glucose) is injected within the veins of healthy animals (in whom previous examination of the kidney excretion was "negative" as to sugar) the dextrose thus injected disappears rapidly from the circulation, the kidney excretion showing no trace of it. They found also that in depancreatized dogs (in whom the pancreas had been removed by operation) the injected dextrose was not absorbed from the circulation—this fact being proved by the kidney excretion being saturated with sugar. But when, with the injection of dextrose, an emulsion of pancreas was simultaneously injected in such dogs, the dextrose disappeared, was evidently assimilated, filling the uses which carbohydrates have in the bodily economy; in these latter experiments no sugar appeared in the kidney excretion. One may thus conclude that in many, if not in all cases, of diabetes, there is failure of the pancreas to fill its office; that in health the pancreatic juices, which enter the intestine through the pancreatic duct immediately below the stomach—that these juices normally furnish ferments digestive of carbohydrates. The stomach, by the way, does not digest carbohydrates. Moreover, all starches used as food become sugar in the living body by the simple process of taking up a molecule of water (H_2O); thus starch ($C_6H_{10}O_5$) becomes glucose ($C_6H_{12}O_6$).

When, then, the pancreas fails to furnish the necessary ferments by which such conversion is effected, the unabsorbable carbohydrates overload the circulation to no effect, are strained out by the kidneys, the resulting excretion furnishing to the physician the proof of the sugar sickness.

So it is hoped that Dr. Meltzer and Dr. Kleiner, or some of their colleagues may, on the basis of these findings, perfect a remedy potent against diabetes. Such a remedy would logically be a preparation of the pancreatic gland of the sheep or some other bovine (the sweetbreads) which preparation would contain the carbohydrate-digesting ferments now presumably lacking in many, if not in all, cases of human diabetes. We would here have an analogue of the extract of the sheep's thyroid, which has been so amazingly effective in the treatment of the functional disease called myxoedema.

It is not probable, however, that such a pancreatic extract will be curative of all cases of diabetes, because there are certainly many cases of this disease in which the glycogenic function of the liver is either in abeyance or is overworked. The theory has for long been very valid that it is part of the business of the liver to store up, in the comparatively vast reservoirs of that huge organ, glucose in the form of glycogen (dehydrated glucose), to be redelivered to the circulation in the blood of the hepatic vein, as glucose, so that the muscles may do their work and the bodily heat be maintained. The pancreas may be doing its full duty in the premises, but if the liver be shirking its duty, or more carbohydrates be eaten than that organ can stow away, then the excess glucose will saturate the blood, and the "case" will manifest diabetes. Here obviously it will not suffice to administer a pancreatic extract. Starches and sugars will have to be considerably reduced or cut out of the sufferer's dietary.

And yet it has long been very certain that there are instances in which neither the pancreas nor the liver can be primarily at fault. How many a "case history" relates an extraordinarily emotional or neurotic temperament, either acquired or hereditary. And it has been abundantly proved by animal experimentation that blows on the head or the spine or the abdomen, or irritation of the floor of the fourth ventricle in the brain, will render a sugar-saturated kidney secretion; in such cases the shock to the nervous system has certainly developed the diabetes. It is a basic fact of biology that normal functioning of any organism as a whole depends on the normal functioning of its nervous mechanism. A nervous system out of gear, a "shoddy" nervous system, will certainly affect untowardly the rest of the bodily machinery. And many cases, some physicians indeed believe all cases of diabetes come about by reason of a nervous system below par reacting, through the sympathetic ganglia, on the pancreatic and the hepatic functions.

In cases, then, where the nervous system is primarily at fault, neither pancreatic extracts nor starch-and-sugar-free diets, will altogether serve; some remedy addressed to the nervous system is also "indicated." By these three therapeutic means then may the cure of diabetes be hoped for, a consummation, indeed, devoutly to be wished. For this is at present a grave disease, anomalous especially in that the young almost always die of it; while, on the other hand, the elderly—who generally succumb to maladies which the young survive—the elderly diabetics, though they are seldom free of sugar in the kidney secretion, are nevertheless likely to live along comfortably enough despite that fact, and to pass away no sooner than their neighbors, of some other disease than diabetes. The sedentary, by the way, are most prone to diabetes; athletic people and manual laborers least—being able, by reason of their manner of living, to "get away" with all the carbohydrates they consume.

The Magnetic Survey of the Globe

ON April 1st, 1904, the Carnegie Institution of Washington founded its Department of Terrestrial Magnetism and assigned to it the task, among others, of carrying out, with the co-operation of the existing magnetic institutions of all countries, a general magnetic survey of the globe. This great undertaking is now rapidly approaching completion. According to Volume Two of the Department's *Researches*, just issued, it is expected that the general survey of the portion of the globe lying between about parallels 70 degrees N. and 65 degrees S.—in other words, all but the polar regions—will be finished by the end of the year 1916.

The work already achieved by the Department of Terrestrial Magnetism is impressive, and stands as a monument to the wise policy which the Carnegie Institution has pursued of devoting the greater part of its immense resources to a few large projects, among which the work in terrestrial magnetism has been one of the most important and costly. During the nine years 1905-1913, inclusive, the survey vessels of the department covered 160,600 miles, and determined the magnetic elements completely at average intervals of 175 miles. The land expeditions of the department covered 800,000 miles and established about 2,500 stations, at intervals averaging 75 miles. Thus, by land and sea these expeditions traveled, in round numbers, a million miles, or forty times the circumference of the globe.

Land expeditions were sent out to the number of 38, 4 polar expeditions were co-operated with, and magnetic work was done in 103 countries. The department devised and constructed 7 magnetic instruments for special use on land or at sea. About 125 articles and memoirs on various phases of the work appeared under the authorship of various members of the magnetic survey staff.

Hardly less important than its own surveys has been its work in unifying and co-ordinating the surveys carried on by other organizations. The magnetic standards used by these organizations are compared from time to time with those of the Carnegie Institution, thus making possible a strict correlation of all magnetic data obtained the world over.

Great Britain has recently undertaken a new magnetic survey of the British Isles as based on the fundamental Rücker and Thorpe survey, and various other surveys have been undertaken by European governments mainly under the stimulus of the Carnegie Institution work.

The magnetic survey expeditions sent out by the Carnegie Institution have, in several cases, penetrated little known regions, under conditions of much danger and difficulty, and have contributed to geographical knowledge. The volume of results just published contains interesting field reports of observers who performed adventurous journeys along the coast of West Africa; across the Sahara from Algiers to Lagos, *via* Timbuktu; across Australia from south to north; across South America both longitudinally and latitudinally; through the wilds of the Hudson Bay country, etc. Happily, no loss of life has thus far attended any of these survey expeditions.

If the Department of Terrestrial Magnetism of the Carnegie Institution of Washington would adopt a short name for itself, the recorders of scientific news would be truly grateful.

Science

New Comet Discovered.—A telegram received at Harvard College Observatory from Prof. E. B. Frost, Director of the Yerkes Observatory, Williams Bay, Wis., announces the discovery of a comet by Mr. John E. Mellish, in the following position:—

September 6.923 G.M.T.
R.A. 6h. 37m.
Dec. +8° 50′.

The comet was small, with a bright nucleus and tail, and was visible in a small telescope.

"Scorching" of Leaves by Wind Action.—Messrs. Barker and Gimingham, of the University of Bristol, have investigated a mysterious "scorching" of the foliage of apple trees, which was at first thought to be due to a fungus or to injury by spraying. It was found, however, to be the result of friction between adjacent leaves, the rough edge of one leaf irritating the cells of another and developing a purplish discoloration, which later turned brown, dried up and presented the typical scorched appearance. The writer suggests that much of the injury heretofore ascribed to spray mixtures may really be the result of wind action.

The Association of Official Agricultural Chemists is an organization formed for the purpose of securing uniformity and accuracy in the methods, results and modes of statement of analyses of fertilizers, soils, cattle food, dairy products, human foods, medicinal plants, drugs and other materials connected with the rural industries. The association is about to begin publishing a quarterly journal in lieu of the official publications formerly issued for it by the U. S. Department of Agriculture, which contained the proceedings of the annual meetings, together with notices of provisional and official methods of analysis. Information concerning the new journal can be obtained from Dr. Carl L. Alsberg, U. S. Bureau of Chemistry, Washington.

Seismic Zones and the Barometric Gradient.—Dr. S. Nakamura, writing in the *Proceedings* of the Tokyo Mathematico-Physical Society, describes investigations that he has carried out to test the hypothesis advanced by Hasegawa and Nagaoka, according to which the barometric gradient is generally at right angles to a dislocation line or seismic zone at the time of an earthquake. The records of fifty earthquakes observed at Tukuba in 1904 were examined and compared with the barometric gradient at the time of each quake, as obtained by graphical interpolation from the meteorological records of Tukuba and neighboring stations. The result shows that the general direction of the gradient was, in fact, more or less perpendicular to the seismic zone previously determined by Prof. Omori by the grouping of epicenters. The author suggests that this apparent relation may aid in determining the location of unknown seismic zones or lines of dislocation.

Radium in Sea Water.—Prof. Stewart J. Lloyd of the University of Alabama, has recently published the results of an examination for radium of a sample of water obtained in the Gulf of Mexico, about 200 miles south of Mobile, and has given in this connection a résumé of the results obtained by other investigators in measuring the radium content of sea water. The writer explains that the growing recognition of radium as an important factor in geological processes has led to many analyses of rocks, soils, springs and river waters for that element, while our greatest reservoir of radium, the ocean, has received but little attention. Joly, who examined samples from several oceans and seas, obtained a value for the radium content so high that it cannot be reconciled with the values obtained by Eve and Satterly for the North Atlantic, and Lloyd for the Gulf of Mexico. Excluding Joly's results, the author finds the average to be 1.2×10^{-12} gramme of radium per liter of sea water, which would make the total radium content of the ocean about 1,400 tons.

Agricultural Meteorology will be represented by several charts in the forthcoming agricultural atlas of the United States, which is to be issued by the U. S. Department of Agriculture. The Weather Bureau is now preparing for this work a series of new rainfall charts of the United States, which will differ from previous charts in presenting detailed data of the rainfall over the western states, where water supply is a matter of much importance, but where, owing to the sparsity of meteorological stations, it was, until recently, impossible to draw isohyetal lines representing the distribution of rainfall with reasonable accuracy. The new charts will show the average precipitation in all parts of the country during the 20-year period 1895–1914, all short records being reduced to this period by the usual method of comparison with data from long-record stations. Other charts in the atlas will present various meteorological statistics of special interest to the agriculturist, such as data concerning the frequency of droughts, the length of the frostless season, etc. In this connection it is interesting to recall the fact that the first installment of an agricultural atlas of the Russian Empire, planned to be the most elaborate work of the kind ever undertaken in any country, was published about two years ago. No further parts have yet appeared.

Automobile

Insulated Screwdrivers.—With the growing use of the high-tension ignition and starting systems on automobiles the necessity of having insulated tools has become daily more evident. The most recent offering along these lines is a rubber handled screwdriver, in which the covering meets the blade flush, so that there is no shoulder.

Opening the Automobile Door Electrically.—In many cars it is awkward for the chauffeur to open the automobile door. With this in mind, Thomas A. Porter of Tuckahoe, N. J., provides a sliding door which is spring closed but can be opened by closing an electric circuit operating in connection with a solenoid which moves an armature connected with one arm of a bell crank lever whose other arm is connected with the door.

Supporting the Edges of the Vacuum Tread Cups.—A patent has been granted to Wilmer Dunhar of Greensburg, Pa., for a vacuum tread for tires in which the sealing edges of the cups are maintained in shape by ribs which traverse the cups and connect the walls of their respective cups together to brace them and are capable of compression prior to the compression of the cup walls so that they will maintain the latter in shape.

Rubber Tires for Steam Tractors.—Tests conducted in Great Britain have shown that the use of rubber tires on the huge wheels of steam tractors greatly increases the efficiency of the vehicles. Before the war, no one dreamed of putting rubber tires on the broad wheels of the tractors, but rubber is cheap in England and tires of that material were tried out. The results have been so surprisingly good that the majority of the big tractors, both in Great Britain and behind the battle lines in Flanders have been rubber tired. The tractors formerly had either steel or wooden plug tires.

Tire Output in 1915 Worth $250,000,000.—According to the manufacturing plans of the thirty large rubber-tire companies in the United States, their output during the present calendar year will exceed 11,000,000 tires, of an average value of $20 at retail. The remaining smaller companies, supplying local trade only, produce about 1,000,000 tires in twelve months, worth $18 to $22 a piece. The total value of tires used in 1915, including solid tires for trucks, tires for buses and taxicabs, amounts therefore to $250,000,000 in round numbers. To this sum should be added about 200,000 motorcycle tires, worth from $5 to $10 each.

Japan Rushes Tire Manufacture.—Japanese rubber factories are working at top speed at present endeavoring to capture the Far Eastern market, before the British and German manufacturers can again become competitors. Heretofore, American manufacturers have been too busy in the home market to bother about establishing a market for their tires in Asia and Australia, and unless steps are taken along these lines in the immediate future, they will find the market pre-empted by the Japanese. Japan imported about 2,500,000 pounds of rubber in 1913 and 1914, while in the previous years only about 2,000,000 pounds were used annually. The capital invested in the industry is $2,500,000 and the workingmen number about 4,000.

Testing Trucks for War Use.—How rigorous are the tests for motor trucks submitted to the French government may be judged from the following description of a typical "try-out" to which the trucks are subjected soon after being taken off the ships. Two drivers are put on each vehicle, which is sent to the front as part of a convoy of 20. Each convoy is in charge of a lieutenant in a touring car. One of the trucks is fitted out as a repair shop, while another carries the cooking stove and kitchen outfit for the men. The convoy is sent over the hilliest and toughest country (*not roads!*) in northern France. The four-wheel-drive machines, of which an ever-increasing number is now used, are compelled to go through a ditch so deep that there remains a clearance of but a few inches at the front, when the rear is elevated. No "green" driver can possibly get by, in such a test, while the work is so strenuous for the trucks that a great many fall by the wayside. One of the first trucks subjected to the ditch test broke the starter handle clear off—in the bottom of the ditch—showing at what a steep angle it was driven.

Handling Used War Trucks.—As reported in the SCIENTIFIC AMERICAN several weeks ago, it is the intention of the German government to form an alliance with motor truck manufacturers for the purpose of organizing the return of used war trucks to the general public, under conditions which will preclude a panic and will guarantee satisfactory prices for used trucks in good condition. The plan, as outlined, comprises the gathering of all returned trucks by one large company under government supervision, and the placing on the market of one third of the trucks each year for three years. A company has now been incorporated for this purpose under the name Feld-Kraftwagen Aktien Gesellschaft, with a capital stock of 1,000,000 marks. The directors include leading men in the business world of Germany, government officials and bankers. All requests for information should be addressed to the Disconto Gesellschaft, Berlin, W. 8.

Inventions

Novel Varying Headlight.—A headlight patented by Adam Frederick Kush, of Toledo, Ohio (No. 1,148,101), is characterized by a plurality of concentrically arranged casings, each of which has an independent light. The lights are capable of use independently or collectively to vary the intensity of the light.

Hard on the Hen.—For the purpose of breaking hens from setting, Ernest O. Marvin, of New York city, in a patent, No. 1,148,394, shows a number of hollow nest eggs joined in a series by connecting tubes and means for circulating cold water through the eggs to overcome the natural and laudable ambition of the hen.

Cap With Electric Light.—Frank A. Walters, Werner M. Beckman and Aaron W. Kohl of Minneapolis, Minn., in patent No. 1,146,979 disclose a cap having reversely extended pockets on opposite sides of an electric lamp with battery cells for supplying current to the lamp concealed in the said pockets.

Anticipating Prior Use.—In Diamond Patent Company v. S. E. Carr Company, the court said that prior use, referring to anticipation of a patented invention, must be so far understood and practiced or persisted in as to become an established fact, accessible to the public and contributing definitely to the sum of knowledge.

Hydroaeroplane Float.—Thomas Sloper of Devizes England, has a patent, No. 1,148,340, for a hydroaeroplane whose float is of flexible material, kept in shape by being filled with gas under pressure and the landing wheel is so supported from the float that the latter serves as a cushion between the wheel and the part of the hydroaeroplane supported by the float.

Prevents Theft of Incandescent Lamps.—Patent No. 1,148,538 has issued to the Hart and Hegeman Mfg. Company of Hartford, Conn., as assignee of Joseph Sachs, of the same place, for a novel construction of catch ring and locking band for application to an electric lamp and socket in such manner as to prevent the lamp from being stolen.

Umbrella With a Fan Attachment.—To circulate air below the canopy of an umbrella a patent, No. 1,148,332, has been issued on the invention of Sylvester Onyskow, of Jenkins, Ky., in which a fan with folding blades, so that it can collapse with the umbrella, is arranged directly below the canopy and a suitable motor battery and switch mechanism for driving the fan is also carried by the umbrella.

Aeroplane Stabilizer.—James M. Reynolds of Butte, Mont., has secured patent, No. 1,148,050, which presents in an aeroplane, a plurality of engines with shafts, driving propellers together with an aviator's seat so connected with the engines that the aviator may, by moving the seat, readily tip each propeller in opposite directions relatively to the supporting surface of the aeroplane to aid in stabilizing the machine.

Utilizing Scrap Leather.—The scarcity of leather is illustrated in patent, No. 1,148,584, to Edward W. Gerrish of Lynn, Mass., in which scrap pieces of leather are utilized by mortising or dove-tailing the edges thereof, so that a number of scrap pieces may be secured together to form a sheet, a thin layer of material being applied over one entire face of the united pieces to cover the joints and to preserve the effect of an integral piece or sheet of leather.

An Equalizer for Airship Drive Mechanism.—Patent No. 1,148,280, granted to Harry N. Atwood and David D. Sternbergh, of Reading, Pa., provides in an aeroplane a front pair of propeller shafts and a rear pair of propeller shafts and a propeller drive shaft in separate sections. Each of the rear propeller shafts is connected to a front propeller shaft by a differential gearing operatively connected to one of the drive shaft sections for the purpose of equalizing the drive.

A Safety Emergency Exit.—Ernest H. Peabody and Walter B. Tardy of New York city have patented (No. 1,147,885) an emergency exit for closed magazines or turrets of battleships or engines or boiler rooms, cargo spaces, or other compartments in vessels. The exit is in the nature of a trap which may be filled with water to prevent steam or noxious gases from following the escaping persons and vitiating the atmosphere outside. The trap form of the exit permits the uninterrupted passage of persons from a compartment to the exterior, and at the same time prevents the passage of gas or vapor.

Trade-Mark After Copyright Expiration.—The Supreme Court of the United States, speaking by Mr. Justice Day in the case of G. and C. Merriam Company v. Syndicate Publishing Company, has held in effect that where the trade-mark registration relied upon having the name "Webster," as applied to dictionaries of the English language, as their chief characteristic, and was made long after the expiration of the copyright securing for the publishers the exclusive right to publish the Webster dictionaries, it is well settled that after the expiration of copyright of that character, the further use of the name by which the publication was known and sold under copyright cannot be acquired by registration as a trade-mark, for the name has become public property and is not subject to such appropriation.

A Thinking Machine, Planning and Theories

Mechanical Reproduction of Mental Processes

By S. Bent Russell

THE readers of this journal may remember the description of an apparatus designed by the writer that will perform operations exhibiting memory associations. Such associations constitute a large part of mental processes. Most people, indeed, do not realize how great a factor association is in brain work.

There are, however, some forms of behavior that cannot be explained by reference to association alone. Something more must be provided.

May we not venture to speculate on possible modifications of the memory machine, above referred to, which would enable it to imitate these more complex forms of behavior. It is the purpose of this article to suggest some such modifications and what they might accomplish.

To begin with, let us consider the nature of a *routine performance*, by which is meant a definite series of muscular movements which is habitually executed in response to a cue given by one or more signals. For example, when a dog is made to "fetch," he goes through a routine performance.

By way of explaining it, we may say that each movement of such a series is excited by afferent impulses from the muscles and other parts affected by the movement that preceded it. These are known as kinaesthetic impulses. By virtue of association in the form sometimes termed substitution, these kinaesthetic impulses, after suitable training, will link the routine movements together. The first diagram, we will say, is a nerve mechanism for a child committing the alphabet to memory. The points *SA*, *SB*, *SC* represent sensory terminals excited by the printed letters while learning and the solid lines are the nerve pathways that lead to the motor terminals which give the movements *MA*, *MB*, and *MC* of pronouncing the letters. The dotted lines *MA-b* and *MB-c* show the paths of afferent impulses from the muscles when moving. After proper training, the signal *SA* causes the movement *MA*, which is followed automatically by movement *MB* and then by movement *MC*, etc., all of which is due, of course, to the increased conductivity along *MA-b—MB*, and *MB-c —MC*, etc.

The question before us is how to modify the memory machine so that it can be trained to execute a routine performance. Let us base our planning on the belief now held by many authorities that mental processes are largely a matter of varying conductivity of the nervous pathways that connect the sense organs and the muscles. Of course many readers will find this a difficult assumption. From any point of view, however, it will be seen that time and movement are the important factors in memorizing.

Mechanical Device.

Let us now consider briefly the memory machine, or mechanical apparatus, that will respond to signals as a nervous system does, i. e., the responses are determined by previous experience. The responses simulate inhibition, association, substitution, etc. It may be described as a hydraulic regulating system.

The details of the apparatus have been given in published articles, and the device has been shown to be perfectly practical by the construction and operation of a working model shown in the illustration.

The elements of the apparatus are shown in the next diagram. The vertical lines marked *SS*, SR_1, SL_1, etc., are key rods which are connected by bell cranks as indicated, to rods shown by horizontal lines which act on the transmitters, each of which is indicated by a square with a diagonal line. The connecting lines on the right of the transmitters represent the meter pipes which lead to the hydraulic cylinders shown on the right. A complete apparatus made up of similar elements may be termed a memory machine, but for the sake of a shorter name we will term it a memory gear.

A signal is given by striking a certain key rod. The response may be one of several movements or several simultaneous movements, depending upon the state of the connected transmitters, i. e., upon their previous operations.

The key rods, transmitters and meter pipes may be connected up in a variety of groupings or combinations.

As to general analogy of the apparatus to a nervous system there will be some readers who are repelled by the obvious differences between a base mechanical contrivance and a community of living nerve cells and fibers. It may help to overcome this feeling if you consider that there is a correspondence of the sort shown in Table I in parallel columns.

TABLE I.—POINTS OF CORRESPONDENCE.

NERVOUS SYSTEM.	MEMORY GEAR.
Sense organ and fibers leading from it, where the impulse originates.	Key rod and connecting parts, where the impulse originates.
Association brain fiber which changes with use and disuse.	Transmitter valves which change with use and disuse.
Nerves which conduct the nervous discharge to the muscles.	Meter pipes which conduct the flow of water to the governing valves of the hydraulic cylinder.
A pair of opposed muscles, each governed by a converging group of nerve fibers coming from the brain. The muscles receiving the greater discharge prevails.	A double acting hydraulic cylinder governed by two rival collecting pipes that are fed by the meter pipes coming from the transmitters. The collecting pipe receiving the greater discharge prevails.

The machine and how it thinks.

In the machine the arrangement is such that if two key rods are connected to the same transmitter and the two rods happen to be struck in succession, the transmitter will give a greater discharge thereafter.

The difference in growth of discharge for a transmitter operated twice on each occasion over that for one operated once each time will depend upon the length of the interval. We can consistently assume a certain adjustment of the transmitter and for a case of regular intervals between signals we can compute the effect of double signals. Table II gives such a comparison

TABLE II.—RATE OF INCREASE FOR A TRANSMITTER.

Interval in Minutes.	Gain per Interval.	
	Single Signal.	Double Signal.
40	0	0
20	0	40
15	10	50
10	20	60
5	30	70
0	40	80

and shows the increase in discharge through a transmitter operated at regular intervals of from five to forty minutes.

The values given for gain in rate of discharge are only relative. They are computed on the basis that single signals in rapid succession give an increase of 40 for each and that the decrease between signals is at the rate of two per minute.

In the above described apparatus all signals are from the environment, as it were. But as has previously been shown, to link movements together into a routine performance, there must be counter (or return) signals like the kinaesthetic impulses in an animal. We will term such signals secondary counter signals.

A Compound Memory Gear.

Such signals in the animal do not come from the outside, hence to make our mechanical apparatus correspond, a modification should be made. Let us provide two memory gears so placed that the hydraulic cylinders of the first will operate some of the key rods of the second. When a certain key rod of the first memory gear is struck it will cause one or more movements by the first gear and one or more movements by the second gear. A movement by the latter will be determined by two transmitters in series, one of each gear.

The term "compound memory gear" will be applied to such a combined apparatus where certain (secondary) key rods are moved by hydraulic cylinders governed by other (primary) key rods. Such a memory gear might be so arranged that it could be trained to execute a routine performance so that after a number of lessons a single signal would start a train of movements, like a child repeating the alphabet.

We may observe that every spoken word is a routine series of vocal movements. In a dialogue each speaker makes a series of vocal movements, and gives a starting signal to the other speaker who makes a series in turn. Each vocal movement by means of a nerve impulse excites the next vocal movement. So you see by our first modification of the memory gear we have given it the power of linking responses in series or movement systems. But this is the essential part of language learning, so we have made an important advance, for language is a great factor in mental development.

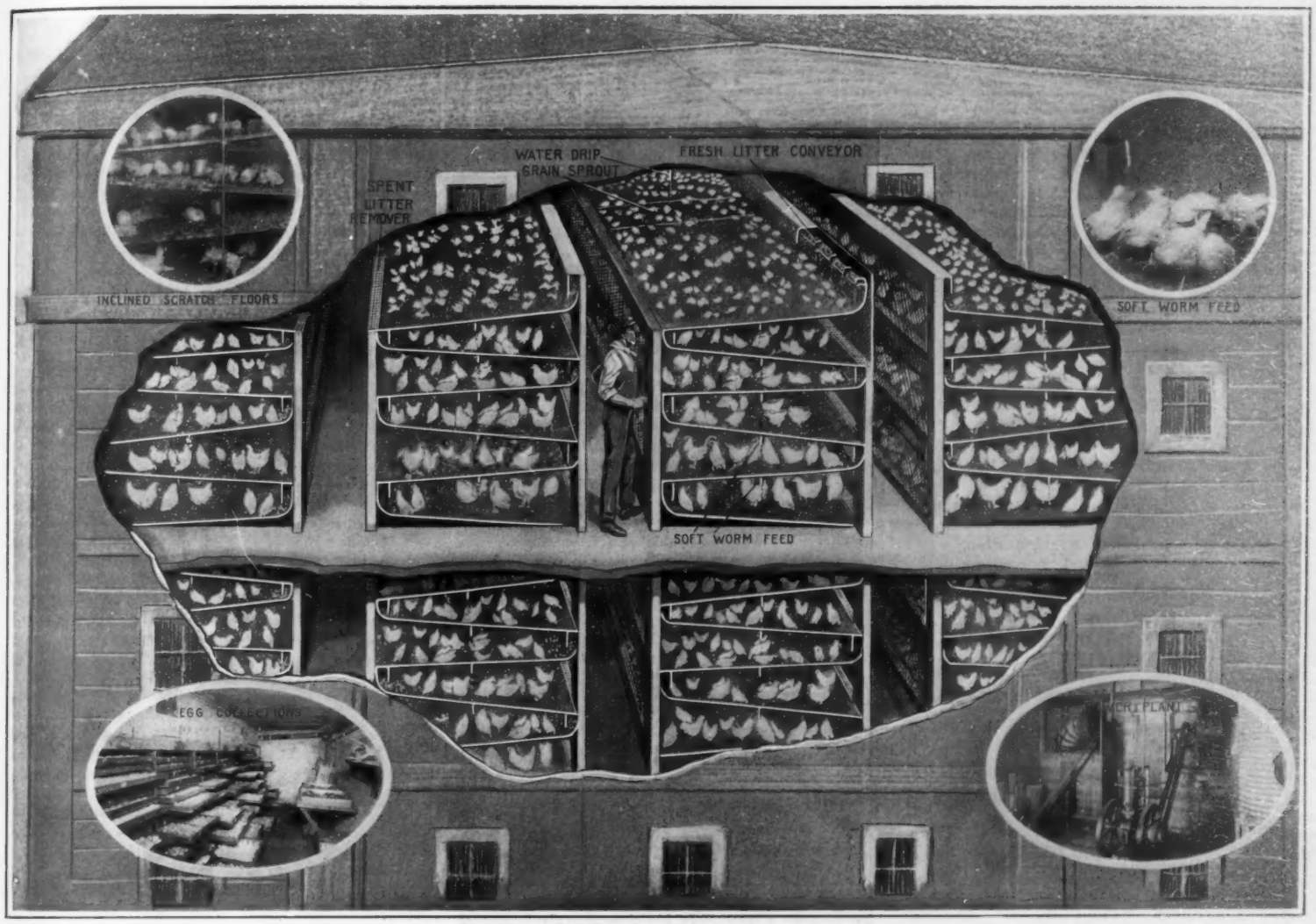
Thinking.

Just as vocal movements can be linked together in a routine performance so can incipient vocal movements be linked together, and thus we get a typical train of thought.

We have already observed that muscular movements are registered in the nervous system. There is good reason to think that all muscular strains also are registered in the same way, so that in the case of interfering movements, the movements that are incipient only leave their impress on the nerve fibers.

To explain more definitely what takes place, the writer would venture to propose two alternative assumptions. The first one is that a faint excitation of an efferent or motor fiber is conducted slowly through the muscle to an afferent fiber without causing contrac-

(*Concluded on page 257.*)



A million chickens to the acre. Sketch plans of an ideal chicken factory.

A Million Chicks to the Acre

Raising Poultry on a Manufacturing Basis

By Milo Hastings

SIX years ago I found myself a very properly educated and widely experienced scientific poultryman, but with a personal need for more income than men without capital are able to earn in the poultry producing business. My schoolmates in various branches of engineering and commerce were in line for five-thousand-dollar jobs, but the best I could hope for, with all my scientific education, was to equal the wages of a carpenter.

I asked myself why there were no better paying positions in the poultry business, and the obvious answer was that the billion-dollar total was divided into millions of small producing units, no one of which was large enough to pay for creative brains in competition with manufacturing industries.

The weaving of cloth, the making of shoes, the killing of hogs, and the churning of butter had been taken from the ranks of household labors and centralized under corporate control with outputs a hundred or a thousand times as large as that of the original farm plant.

Why, then, did not the same principle apply to chicken growing? In answer, the men wise in poultry lore said, "chickens need personal care," or "you cannot raise living creatures by machinery," or "animals must have natural conditions." But these are mere vagaries. The longer I studied the problem, the more thoroughly I became convinced the greatest difficulties in the way of the industrial centralization of chicken production was human prejudice and not biological laws.

The one sure way to induce a change in the methods of industry is to lower the cost of production, and particularly the labor cost. This usually means the substition of machine for hand labor. To utilize machine labor one must concentrate a large amount of work to be performed into a relatively small space.

The space occupied by chickens is not great except when the chickens range at large on the natural soil. Yarded chicken, when carefully provided for in every need, produce better than do chicken on range. All fowls, both young and old, must be kept indoors in the winter months. A few poultrymen have recently attained success with laying hens kept indoors the year round. Clearly the need for a wide expanse of soil for the chicken is not unchallengeable.

If chickens will thrive indoors, why can they not be reared upstairs, and if upstairs, why do the chicken quarters need be 10 feet high for a tenant that is scarcely 10 inches? Now, we need the extra ceiling height for the chicken man, but if we replace the man by mechanism, this space becomes a useless waste.

Let us figure the same floor area that is now standard practice and floor heights of 12 inches for little chicks and 20 inches for hens, with 25 per cent space for aisles, etc. We find that a building covering an acre of ground and 50 feet in height would have a capacity of 250,000 hens or 2,000,000 young chicks. All the poultry of the United States could be roomily accommodated on Manhattan Island south of Fourteenth Street. If we allow a land rental charge of a cent a chick and grow four broiler crops a year, an acre of land would yield a rental of $80,000. This is far fetched, but it is sufficient to show that such a plant need not be a rural institution, but should be located within the cities' border, whence the deliveries could be made daily to the consumer without recourse to railroad shipment. Such a location of the producing plant offers a weapon to fight the middleman that is more substantial than talk.

Chicken feed is cheaper in the freight yards of an eastern city than on an eastern farm, for eastern poultry farmers depend on western grain, paying seaboard freight plus freight to the local town and the wagon haul.

In a concrete building with interior fixtures of steel and with the use of slow-burning peat moss litter, a serious fire is impossible, hence there would be no practical limit to the size of a plant except that of the demands of the tributary market.

With the concentration in space herein suggested there is an enormous increase in the capacity of the building as compared to the exterior radiating surface. This works a great economy in heating, or more properly temperature control, as pumping cool water through the radiators in summer might prove as profitable as heating in winter. The same concentration in space makes feasible the ventilation with blowers and puts air exchange, air distribution and humidity under absolute control.

This virtually means a controlled climate, and climate is the cause of 70-cent broilers in April and 30-cent broilers in September, or the 60-cent eggs of December and the 20-cent variety of the spring months.

The complete control of the temperature has an even more significant application in the rearing of young chicks. The current practice is to imitate nature by providing a heated cover beneath which the chick may go as beneath a mother's wing. The remainder of the brooder house, we are told, must not be warmed.

A few years ago I constructed and operated a mechanical draft hatchery having a workroom with a floor temperature that was held constantly at a little less than 90 degrees. I divided a lot of chicks, keeping half of them on this floor and sending the remainder out to be reared in the conventional brooders on the farm. When broiler time arrived the uniform temperature chicks had lost but 4 per cent, while nearly half of the brooder-reared flock were missing. I have repeated this test a number of times since and always with gratifyingly small losses from the flocks where the chicks could not become chilled by straying away from the proper heat.

The plan of superposing many floor levels of chickens one above the other renders it difficult to get daylight to the chicks. I conceived the idea of substituting artificial light for daylight. My first effort at growing chicks by electric light was in 1911. I have repeated the experiment on several occasions since, and at the present writing have several hundred chicks of various ages which have never seen the light of day. I have other lots which were grown for a time under daylight

Continued on page 257.)

Strategic Moves of the War—September 8th, 1915

By Capt. Matthew E. Hanna, Recently of the General Staff, U. S. A.

DURING the week covered by these notes there have been no spectacular or decisive operations in any of the theaters of war. At the same time there has been hard fighting on both the eastern and western fronts. For more than a week the Allies in France and Belgium have subjected the German lines in their front to a bombardment by artillery of all calibers, and there was good reason for believing that this was the prelude to the long expected offensive by the Allies in the west. The most recent reports indicate that this bombardment is dying down without there being any indications of an infantry attack to follow it up.

The casualties of the British and French during the past six months have been very considerable, probably amounting to some thousands per day—the most reliable reports say two thousand per day for the British and five thousand per day for the French. The great majority of these are wounded men who can be returned to the line in time, but even so the daily drain is very considerable, and evidently the Allies in this theater think the time has not yet arrived when they should resort to a general offensive movement which would be terribly expensive in lives and material and would leave them greatly weakened in strength and morale if it should fail. No doubt the prolonged bombardment of the German lines served to keep in this theater a large number of German troops during a period when they could have been used to very great advantage on the Russian front. To mystify an opponent forms a very important element in the game of war and the plans of the German leaders, no doubt, were considerably interfered with by the necessity of being ready for a French attack, which they naturally would expect to follow the bombardment.

The German answer to the French artillery was an attack along the southern portion of their front in Lorraine and later by the Crown Prince in Argonne. These were made in such force as to indicate once more that the German lines in this theater are held in considerable strength, despite the enormous number of troops they have been sending to the east. The local successes they have secured in France from time to time during the past four months, when this has been a secondary battlefield, indicate that they will sweep over the French and British intrenchments despite their strength and multiplicity if by chance they succeed in disposing of their antagonist in Russia and are able to shift the bulk of their eastern army to the western theater. Without full knowledge of all the conditions in the ranks of the Allies it is not possible to pass judgment on what has appeared to be the inactivity of the Allies in France and Belgium, but there is plenty of reason for the thought that, if the Allies can accomplish nothing decisive on the western front at the present time, they certainly cannot hope to take the offensive with success in the near future, if ever.

In the Italian theater and on the Gallipoli peninsula the Allied cause has been equally unsuccessful in accomplishing any gain of note. There has been active fighting on the northern Italian front in Trentino with the honors equally divided between the Austrians and the Italians. The Austrian line to the east along the Isonzo River continues to hold against the efforts of the Italians to break through it, which have been less determined for the past week or so. We hear less of the shortage of ammunition in the Turkish army, and there has been nothing in recent operations on the Gallipoli peninsula to indicate any probability that the Allies will secure possession of the Dardanelles. There has been active fighting also in the Caucasus region between the Turks and Russians, but not of an aggressive nature. The principle purpose of each of the contending forces in this region appears to be to hold the other in place and prevent reinforcements being sent from here to other more important theaters.

The operations in the Russian theater have not furnished us with their usual quota of spectacular events. The Teuton forces appear to have entered another period of recuperation and readjustment of their lines preparatory to another series of important victories, provided their further operations should succeed as they have in the past. These periods of comparative inactivity have occurred from time to time since the beginning of this campaign some months ago. Victory uses up ammunition and other supplies and disorganizes fighting units the same as defeat, and after each successful advance of the Germans, it has been necessary to put the fighting forces in condition and position before attempting a new series of operations. When the Germans were operating near their own frontiers this could be done in a comparatively short time, owing to the intricate net work of strategic railways running about the Polish frontier from East Prussia to Roumania; but with the advance of the Teuton forces farther into western Russia they have become more dependent on the very inferior railway system of Russia and the shifting of troops, the bringing up of reinforcements and vast quantities of ammunition, and the movement of the wounded to the rear require much more time. The enormous advantage the Germans had in their superior railroad system is now less pronounced and working to the benefit of the Russian.

With the retreat of the Russian army to the east of Brest-Litovsk into the extensive region of woods and marshes extending to the eastward almost as far as the Dnieper River, the Russians' front has been divided into two portions, one extending from the Gulf of Riga in the north to the Pinsk marshes, a distance of about three hundred miles; the other from the southern limit of these marshes to the Dniester River, a distance of about two hundred miles. The line extends through the marshes also, but no doubt is weakly held in this area, for troops cannot operate here in large numbers. The practical result of this has been to divide the Russian army. True enough, this separation may be more imaginary than real, since the two wings of the army may reunite after reaching the eastern limit of the marsh country. Nevertheless, the Teutons are given an opportunity to make the division of the Russian army real and permanent before it has traversed the two hundred-mile extension of marshes from west to east.

The eastern field of the war.

Apparently an important part of the plan of the German General Staff has been to force the Russian army back on these marshes with this purpose in view, and the operations of the past ten days indicate this to be the case.

As an immediate result of this separation of the Russian line, the Russian center is greatly weakened at the points where the line intersects the northern and southern edges of the marsh country. Before the Russians were driven back upon this marsh region they had but two flanks to guard—the northern strongly posted on the Baltic Sea, and the southern, well protected behind the Dniester River. But with the division of their line into two portions, each portion presents an inner weak flank along the marsh country. For more than a week the Teutons have concentrated their efforts in the south against the northern flank of the southern half of the Russian line and have been forcing their columns farther and farther to the east along the southern margin of the marsh land in a strong effort to bend this portion of the Russian line backward to the eastward and southward and separate it completely from the other half of the Russian line to the north. They immediately encountered the fortified triangle formed by the fortresses of Lutsk, Rovno and Dubno, and their advance may be checked sufficiently in this region to enable the Russians to send reinforcements to this portion of their line and save their line once more from being divided. More than a week ago Lutsk was captured by the Teutons and about a week later Dubno also fell. Rovno alone remains as a supporting point for the Russian line, which appears to be in grave danger of being cut off from Russian troops farther to the north.

Should the Teutons succeed in this effort, their success might well mark the beginning of the end of the Russian armed forces in the field. Once the Russian line is definitely split in two we may expect to see the Austro-Germans concentrate against the weaker half and destroy it while maintaining a defensive attitude, if necessary, before the other portion of the Russian line. Success to the Teuton arms south of the Pinsk marshes might drive the southern half of the Russian army to the southward toward Odessa and the northern shores of the Black Sea, unless by chance it should succeed in fleeing to the east, and even in this latter event the shores of the Black Sea would fall into the possession of the invader. There can be little doubt but that this would be a most desirable outcome to the Russian campaign, for with the Black Sea ports in their possession, the Teutons might speedily control this water route to Constantinople. If Turkey is in extreme need of ammunition and other supplies, Germany can open the Black Sea route to Constantinople more quickly and easily than she possibly could secure an overland route through the Balkan States by fighting the united Balkan forces.

To the north, in the region of the Gulf of Riga, the Germans are continuing their powerful efforts to secure the crossings of the Duna River between Riga and Dvinsk, and have met with some success. Victory here would isolate the important port of Riga and lead eventually to its downfall, which would give the Germans a very valuable base of operations within three hundred miles of Petrograd and on the flank of the Russian forces in this region. The flank of the Russian line might be torn loose from the Baltic coast, and if so, the Germans once more would have an opportunity for the wide enveloping movements which constitute so important a part of their strategy.

The Russan line is being hard pushed throughout its length and shows signs of the weakness in morale and material strength which we naturally would expect to follow a disastrous retreat which has continued almost without interruption for four months. The German offensive may have lost some of its impetuosity, but this is probably due more to poorer railroad facilities than to a lack of men or desire to fight, and the drives now being made on the Duna River and just south of the Pinsk marshes probably will increase in power as the Teutons continue to shift their reserve forces into these regions. There is nothing exceptional in the operations of the Allies on the other fronts to give the Russians any hope for substantial relief. Altogether, the plight of the Russian army is very serious.

Photographic Paper to Be Made in America

PRACTICALLY all the paper used for photographic prints in this country has been imported from abroad, but, as in the case of many other imported materials, conditions in Europe are interfering seriously with the supplies, and our manufacturers are turning their attention to meeting the home demand. The main reason why our manufacturers have given this class of paper so little attention was that the principal consumer was well provided for by the foreign product, which it practically controlled.

Paper for photographic purposes must be unusually pure, and entirely free from chemical and mineral matter, which would result in spots and stains on the finished photographic print; and the principal requisite for the manufacture of the proper quality of paper is an abundance of water of a purity not required in any other manufacture. For the reason given above little effort has been made until recently to ascertain whether water of the necessary purity could be obtained in this country; but it is reported that two American concerns have solved the problem, and are making photographic paper, for which the market now exists.

Besides the financial and chemical problems that have been involved there is still another of a technical nature. One of the worst enemies to the production of photographic paper is iron in any form, as it is sure to make its presence known by spots; and after a water absolutely free from mineral salts has been secured special provision must be made in the construction of the paper making machinery to prevent the contamination of the paper by particles of metal from the parts with which the paper comes in contact.

The general nature of the problem has been understood by paper manufacturers for many years, but until the present complications, conditions have not been such as to warrant the building of new mills and machinery, as well as the expensive work of developing and perfecting the details of a new manufacture.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

A Stencil

To the Editor of the SCIENTIFIC AMERICAN:

In issue of July 3rd, 1915, I noticed an article citing the need of a stencil sheet which can be cut dry and thereby avoid gumming up the typewriting machine.

Manufacturers have spent considerable time and money in an effort to produce a satisfactory dry stencil, but without success.

In the absence of a satisfactory dry stencil I have resorted to the use of water to soften the stencil and cut the stencil with a rustproof L. C. Smith typewriter, which costs no more than the regular finish. I get equally as satisfactory results.

Water cannot be used on the ordinary typewriter because of rust, but by using the rustproof machine, rust as well as gumming is avoided and the typewriter is readily available for ordinary typewriting.

Washington, D. C. BERNARD A. HAYDEN.

An Early Device for Taking Submarine Photos

To the Editor of the SCIENTIFIC AMERICAN:

In connection with the submarine moving pictures recently exhibited, an article on "Submarine Photography," by M. Bazin, in your issue of September 29th, 1866, is most interesting.

The method described (page 215) is to inclose the operator in a sealed chamber and lower him to the work. The writer seemed to imagine that the operator had to depend on the inclosed air alone, but it must have been such an obvious thing to supply him with air at atmospheric pressure through a couple of lines of hose that the former thought it not tenable.

This device is much simpler than the Williamson one and may be of assistance not only in getting underwater pictures, but in locating sunken submarines and other wrecks. A very simple chamber provided with electric light and lowered by a couple of chains and with two lines of hose could quickly drop an observer to any depth, where he could direct the placing of chains and such rescue work as must now be done by chance.

The chamber need not be much larger than a kitchen boiler, although stronger, of course, and for observation work the glass sight openings need not be large, but should be on several sides. Every ship could easily carry such an equipment. CHARLES E. DURYEA.

Philadelphia, Pa.

A Suggestion for Citizen Soldiery

To the Editor of the SCIENTIFIC AMERICAN:

It is not without misgivings that I, a high school student, presume to write to a paper like the SCIENTIFIC AMERICAN. I have read with interest and growing perturbation your series of articles concerning the unpreparedness of the United States, and so I am now going to unburden my mind of an idea or two, worthless though they may be. I will at least have a free conscience in case the whole country goes to rack and ruin.

This has to do with the training of our citizenry. Would it be well or not if each State maintained a number of military schools where all boys, whether sound or not and say from 16 to 20 years old, were required to attend? Here they could be given an average high school education as well as military training. Several weeks in camp each summer would give them practical work to do. The present high schools, although unnecessarily large, could still be used for the girls alone to attend. The separation of the two sexes might have bad tendencies, but it also would have some advantages. The mental growth of boys and girls, it is believed by many, differs decidedly in tempo and rhythm. And, from the moral standpoint, there is no question but that the separation of the two sexes would be a good thing. The boy would learn to respect the law. He would acquire a wide knowledge of his fellows and things of the world. If the boy were sickly he would be given expert medical attention, where if left alone to his parents he might be neglected either through ignorance or financial obstacles. Probably the greatest disadvantage of this system would be the inconvenience which the working boys would meet. However, it might be possible to furnish work to boys while at school, upon whom the support of others rested. Then when he came away he would be better equipped than ever to make his living. He would be better morally and physically and, from a military point of view, he should be equal to the average militiaman, particularly if he were required to attend camp a week each summer.

Another thing. In case the question of preparedness came before the people directly, as in a presidential campaign, the average man would probably fight the idea of being required to give up his commercial life, even occasionally, for military training. The only reading of many is the daily paper (which always heralds the building of a battleship or a big gun as an example of American preparedness) or nothing at all. Why not suggest to your readers that they distribute widely their copies of the SCIENTIFIC AMERICAN?

Summitville, Ind. CLEO C. CRANMER.

A Suggestion for National Defense

To the Editor of the SCIENTIFIC AMERICAN:

It is with great interest that I note the remarks which are called forth by the present apparent unpreparedness of the United States in case of war.

I have a suggestion to offer along this line and a reason why it is so difficult to obtain enlistments in the National Guard.

I have investigated the subject to a wide extent, and in the greatest number of cases where I have asked a person why they did not join the National Guard the answer could be summed up in the answer "I would, only in case of trouble in the State I would be called out to perhaps shoot my own relatives." This answer would cover fully 90 per cent of my inquiries.

Now, I want to offer a remedy for this and recommend some changes in the present organization.

To begin with, let the National Guard be formed as an actual United States Government reserve. By this I mean they will be subject only to the call of the President. As to internal State troubles, let the different States organize a constabulary either as a regular body or under call in case of trouble.

Let the National Guard, as above stated, be paid a regular wage, with a fine in case of absence without leave from drill. Have the wage start, say with $5 per month with a private, and gradually increase as the service extended in years or the man advanced in rank, the same to apply to officers. At present there are a great many officers in the guard who deprive themselves so that they may hold such an office, and there are many competent men who will not take such a place, as they know they cannot afford it. By a reasonable wage this condition would be eliminated.

Further, let there be, each year, four weeks of maneuvers in a concentration camp, when the men will be put through a regular course of training, and during this time let the full army wage be paid.

Denver, Colo. AWAKENED.

The Canals of Mars

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of July 10th, a correspondent argues that the discovery of the gradual shifting of position of some of the canals of Mars helps to strengthen, instead of weakening, the theory of irrigating ditches. It does undoubtedly strengthen all the theories of the canals based on the idea that they are strips of vegetation, and it also incidentally strengthens the idea that their formation and maintenance may be due to the efforts of intelligent life upon the planet. But it weakens the explanation of irrigating ditches, as compared with some of the other theories.*

Let us now consider some of these which assume the existence upon Mars of intelligence analogous to our own. Let us first discuss one of those based on the idea that the lack of water is really the chief necessity felt upon the planet. According to this theory, invisible water vapor is evaporated by the heat of the sun from the snowy pole in the springtime and transported by the planetary circulation to the other pole, where the sun is setting for the long winter night. Here the vapor, which forms a much larger proportion of the planet's atmosphere than with us, is condensed as snow, a constant distillation going on by the sun's heat from one pole to the other, and then back again, every year. During the nighttime a portion of this traveling vapor is deposited as fog, and this fog is possibly artificially directed to form elongated narrow areas, by means of liberated electrons or otherwise. In many cases these elongated areas may lie in slightly depressed regions or valleys, where the fog would naturally accumulate of itself. In the early morning on Mars, where the sun is rising, we can sometimes see the fog clear away, and it is in these moistened regions that the vegetation springs up and forms the so-called canals.

But while the lack of water appears at first sight to be the chief necessity of Mars, judged by terrestrial standards, yet such may not really be the case at all, and we might suggest that other needs may be much more pressing. Besides water, vegetation requires several solid constituents, the chief of which, applied as fertilizers, are alkalies, phosphates, and nitrates. On account of its small atomic weight, nitrogen in the gaseous form must certainly be rather rare on Mars. We are just beginning on the earth to have to use our atmospheric nitrogen as a source of nitrates for fertilizers. It may easily be that the Martians have not sufficient quantities of it or of some other of these solid constituents to enable them to fertilize the whole surface of their planet, and they therefore distribute their fertilizer as widely as they can in those places where it will do the most good, occasionally shifting their crops to fresh regions of the planet.

Still another theory, also involving artificial direction, may be based on the fact that, besides solids and water, vegetation requires two gases for its existence—oxygen and carbon-dioxide. While a very important part of the work of plant life is the breaking up of the latter gas and the evolution of free oxygen, yet oxygen is itself consumed in considerable quantities by vegetation, just as it is by animals. We know that there is not very much atmosphere on Mars, and oxygen must be scarce.

But, besides the oxygen, it is quite possible that the carbon-dioxide, too, may be lacking. On our own earth this necessary food for vegetation is provided, not as is sometimes supposed, chiefly by the breathing of the animal world, but by our more or less active volcanoes. Animal life, indeed, furnishes only an insignificant fraction of the total supply. Mars is an ancient world, and any volcanoes that it formerly possessed may now very likely be entirely extinct. In such a case all the carbon-dioxide required by vegetation must be supplied by the animal world, by combustion, or possibly by some other chemical process. To maintain the proper balance between animal and vegetable life, it is clear that the latter must be more or less limited. All useless vegetation would be destroyed, and such as was left would only be permitted to grow in the most favorable and necessary places. Indeed, we find that the canals which when they first appear are very wide, gradually narrow as the season progresses, and this very narrowing may itself be a visible indication to us of the activities of the Martians, perhaps even a gathering of crops!

It is generally believed that the southern hemisphere of Mars is situated at a slightly lower level than the northern one. This is indicated by observations of the Martian terminator. This difference of level has been given as the explanation for the observed fact that most of the Martian vegetation is confined to the southern hemisphere. This explanation would be particularly applicable if there were a shortage of carbon-dioxide on the planet, as it is well known that this gas always tends to collect, on account of its high specific gravity, in any deep depressions of the earth's surface. Even a slight excess might induce the Martians to cultivate these low-lying regions. Vegetations in smaller quantities would be permitted to grow on the more elevated regions, in order to make use of the smaller quantities of the gas found in those places, and it would naturally be spread out in canal-like form to cover the whole area as completely as possible.

Each one of these theories accounts for the canals found upon the planet and for their distribution chiefly in the northern hemisphere, as well as for their shifting and narrowing with the progress of the seasons. If we once admit the existence of intelligent life on Mars, since we have no means whatever of knowing what are their chief needs, it becomes useless for us to theorize further upon their reasons for constructing the canals, otherwise than to say that they indicate a shortage of supplies for vegetation.

Whichever need may be most felt, whether water, nitrogen or carbon-dioxide, it appears that the canals are calculated to meet it, and are what we might ourselves construct or plant under similar circumstances. Indeed, it is possible that the Martians are in severe straits, as compared with ourselves, in more ways than one.

All of these theories avoid the necessity of enormous conduits and the expenditure of an amount of work in pumping, which has recently been estimated by an expert adherent of the pumping hypothesis at 2,500,000,000 horse-power, or four thousand times that of Niagara Falls.

The reason that the writer stated in a former paper, that the irrigation conduit theory was not strengthened by the shifting of the canals, was that the number of conduits would have to be increased if the canals shifted. This does not, of course, disprove the conduit theory, but certainly does not strengthen it, as compared with the other theories explaining the canals, where no such added construction is necessary.

The writer has sought in vain for any theory which will satisfactorily account for the accepted observed phenomena of the canals without resort to artificial direction. The best explanation that he has found is that the canals are due to cracks between floating cakes of ice, but the difficulties encountered in this hypothesis appear to be insuperable, and he has, therefore, been forced to incline to the idea of intelligent direction as a last result. WILLIAM H. PICKERING.

Harvard Astronomical Station, Mandeville, Jamaica, B. W. I.

* Report on Mars, No. 6. *Popular Astronomy*, 1914, 22, 419.

Drawing a spark from the giant coil.

Making a fluoroscopic examination.

The high-tension and high-frequency coil and its designer.

The Austrian Submarines

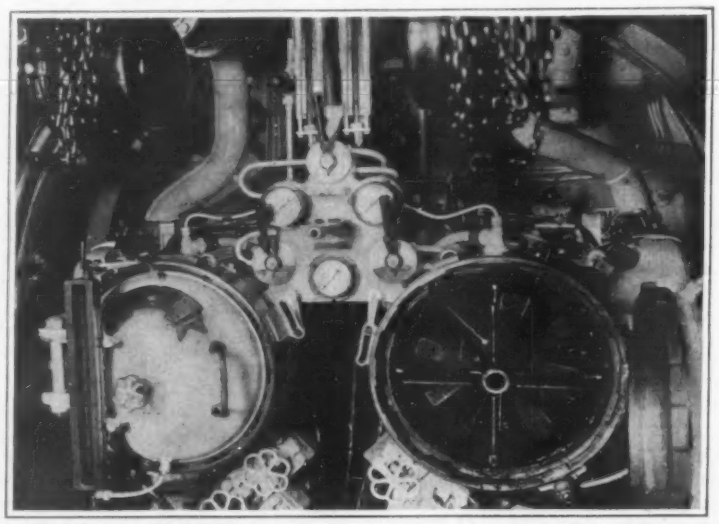
COMPARATIVELY little exact information is available as to the Austrian submarine service, particularly as regards the number and character of the submarines which, at the present writing, are in active commission.

Of one fact, however, we may rest assured, namely, that the Austrian submarine fleet is thoroughly modern; for, according to the most reliable information at hand, the oldest of the boats in service were completed in 1910, and the five latest submarines of which we have any certain information were completed as late as 1914.

It has been frequently stated during the war (and it is probably correct) that Germany has shipped several submarines in sections to the Austrian ports, and that they have been put together and are to-day in service or shortly will be so. Excluding these boats and any losses incurred during the war, Austria possesses eleven submarines. These include two of the Lake type, completed in 1910, which are of about 250 tons surface displacement, have a speed of 7½ knots submerged and 12 on the surface, and carry three torpedo tubes. Also there are two of the so-called Krupp type, which, according to Mr. Lake, are to all intents and purposes his own design, modified somewhat. These boats are of about 300 tons displacement, with a speed of eight knots below the surface and eleven at the surface. They mount two torpedo tubes. The date of the completion of these boats is given as 1910, and in the same year Austria become possessed of two boats of the Holland type, displacing 275 tons, and having a speed of 9 knots submerged and of 12 knots at the surface. These boats also carry two torpedo tubes. In 1914 five much larger submarines of 520 tons submerged displacement were completed. These vessels are of the Krupp or Germania type and they are numbered "U-7" to "U-11." All these craft being designed to operate in the Adriatic are of limited radius of action; but it is quite possible that the boats which have been delivered in sections to Austria by Germany during the war are of much larger size than the foregoing, and are capable of cruising from the head of the Adriatic to the Dardanelles and back under one supply of fuel.

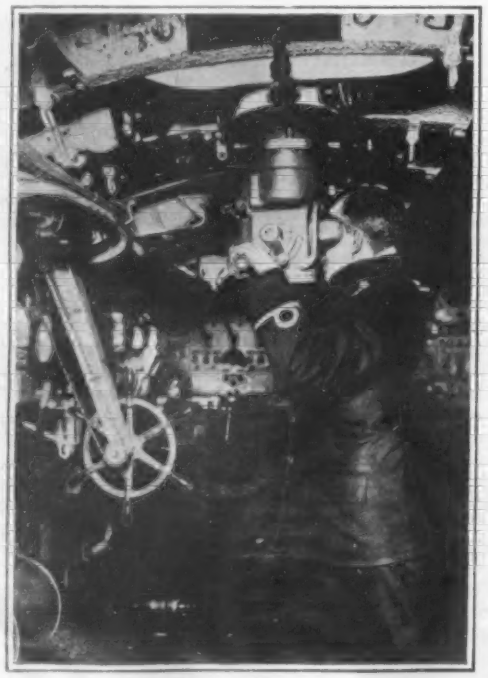
The three illustrations showing the interior of an Austrian submarine give an excellent impression of the large amount of machinery—its complexity and the snugness with which it must be set up in the limited accommodations found in the smaller Austrian submarines of which this is one. Chief in interest is the view which shows an Austrian sub-lieutenant standing at the eye-piece of a periscope. By means of cranks or handwheels he is able to rotate the whole periscope, from the object glass above the surface down to the eye-piece, through a full horizontal circle of 360 degrees, thus commanding the whole horizon. At the time the picture was taken, he was looking to port in a direction transverse to the axis of the submarine. In front of him, supported from the side wall of the submarine, is a handwheel and chain-and-sprocket connection to the steering rods, which lead to the horizontal rudders for controlling the motion of the boat in a vertical plane. Above him will be noticed the arched ribs or frames of the boat.

Another view shows an after torpedo tube with the door closed. It will be noticed that it is built into the boat in close proximity to the roof, the circular framing being visible above it. On each side of the picture are seen the pumps for the compressed air which is used for emptying ballast tanks and firing the torpedoes.

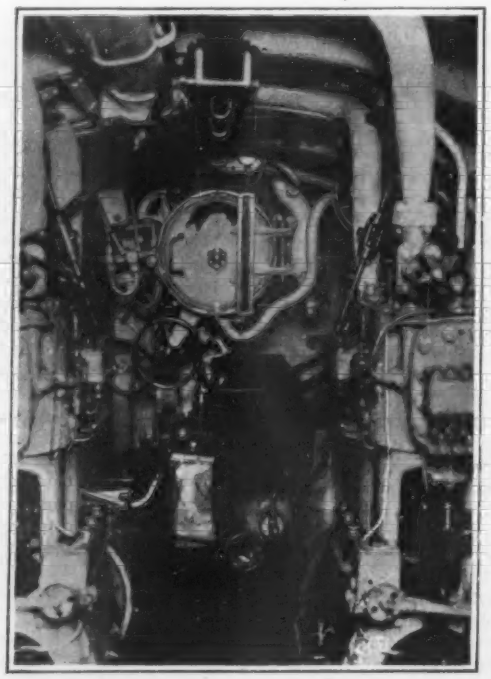


Copyright by Underwood & Underwood

Forward torpedo tubes, one open and showing torpedo propeller.



Taking observations through the periscope.



Copyright by Underwood & Underwood

After torpedo tube; air compressors at each side.

Another photograph shows the forward torpedo compartment with its two torpedo tubes. The one to the left is closed and locked. The one to the right has the door open, showing the torpedo in place within the tube. The blades of the propellers are clearly visible, as is also the central tube through which the air exhausts from the torpedo propelling engines.

A Large Induction Coil of Novel Design

FOR making X-ray photographs and for fluoroscopic observations, as well as for other uses, especially in electro-therapeutics, there recently has been constructed a large induction coil, for which is claimed a wider range of operation than has hitherto been attained with any apparatus designed for the generation of high tension electrical currents of high frequency. This apparatus consists of a huge induction coil 8 feet in length and 37 inches in diameter, constructed by Mr. C. E. Stanley, and demonstrated as well as used in practical applications at his laboratory in New York city. This induction coil, shown in the accompanying illustration, is claimed by the inventor to be the largest coil ever constructed, and is made of eight sections, air insulated, and uses the ordinary street power supply of 220 volts alternating current. By a unique and special arrangement of capacities, inductances, and resistances, this current can be transformed so as to produce a current of extraordinary high frequency and extremely high tension, exceeding, it is claimed, the voltage secured by such means as the familiar Tesla coil. A frequency of one trillion oscillations per minute, the inventor claims, can be attained, and in extreme instances a spark of great length, in some cases, according to his statement, reaching several feet in length. Both the frequency and the tension of the current can be regulated with considerable nicety so that a Roentgen ray tube can be excited in such a way as to emit X-rays for which advantageous and unique properties are claimed. Among these are extreme penetration and rays which do not produce the familiar X-ray burns and other injurious effects. Those familiar with X-ray apparatus will note in the second illustration the absence of the customary lead screens for the protection of the operator, and they will recall the precautions usually taken in X-ray apparatus. Furthermore, the new coil is also useful as a source of high tension currents, which may be applied directly to the human body, and for which therapeutic advantages are claimed, though this is a field which medical science has occupied in no marked degree and as yet without certitude and exact knowledge. High tension currents are believed by some electro-therapeutists to pos-

(Concluded on page 257.)

The Recapture of Przemysl

SOME very interesting photographs have come to hand of the Austro-German operations against Przemysl during the early part of June. It will be recalled that this grievously tortured city, twice besieged by the Russians, finally capitulated on the 22nd of March. After remaining in Russian hands for but two months it was raked again by shell and fire, before which the Russians were forced to retire on the 3rd of June.

The wreckage shown in the accompanying photographs was not all caused by shell fire. Probably most of it was done by occupants of the forts immediately before evacuation. Certainly the uniformity of the destruction as shown in some of the photographs, without evidence of damage on either side of the line of turrets, would indicate that a mine rather than the successive explosions of shells had accomplished the ruin. Indeed it is probable that the smashed turrets were Austrian, destroyed by Austrians before they surrendered the city last spring; for the Russians had not had time to prepare such elaborate defenses. Some of the photographs, however, do bear evidence of the Austro-German attack—our frontispiece in particular. This remarkable photograph shows an exploded 42-centimeter shell, lodged in the roof of a subterranean passage in the middle of one of the forts. The shell had made a clean hole through twenty feet of reinforced concrete. The spiral scoring on the surface of the shell shows how the projectile was revolving as it bored its way through.

The two guns depicted on this page are not 42-centimeter mortars, but the scarcely less celebrated 30.5-centimeter Austrian siege guns, which were used so effectively at Antwerp and other points on the western battlefront. A complete description of these pieces known as the Skoda guns was published in the SCIENTIFIC AMERICAN of July 3rd. The method of assembling and firing them is shown clearly in the photographs. It is interesting to note how the guns are concealed behind an embankment that cuts them off completely from a view of their target.

To Make Coal-tar Dyes in America

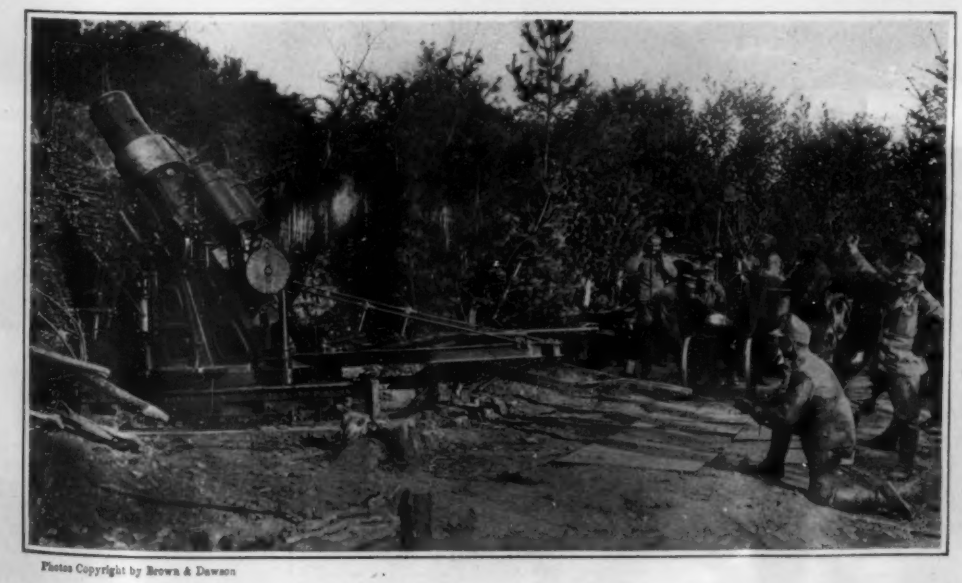
IT has been announced in the daily press that an American inventor has developed an entirely new process for producing dyestuffs from coal tar, and that preparations are now under way looking to the immediate working of the process, which is stated to be revolutionary in its character. A representative of the Government has been investigating the new process, and is reported as having stated that the process would free this country from dependence on foreign markets. Who the inventor of the new process is has not been disclosed, nor are any details of the invention to be obtained. It is stated, however, that large quantities of dyestuffs will be turned out before the end of the year.

Broken turrets at Fort No. 9.

Assembling one of the 30.5-centimeter Austrian siege guns.

Wreckage of turret foundations at Fort No. 11.

Lane of wreckage at Fort No. 10, indicating the work of a mine.



Photos Copyright by Brown & Dawson

Method of firing a 30.5-centimeter Skoda mortar.

Line of turrets destroyed by a mine.

America's Greate

Bassano Dam, Southern Al

By Z. L

THE Bassano Dam, a part of the Canadian Pacific Railway Company's huge irrigation project in southern Alberta, the largest individual project of its kind on the American continent, was informally opened last April by Sir Thomas Shaughnessy, and is the second largest dam in the world, giving precedence only to the Assouan Dam, in Egypt.

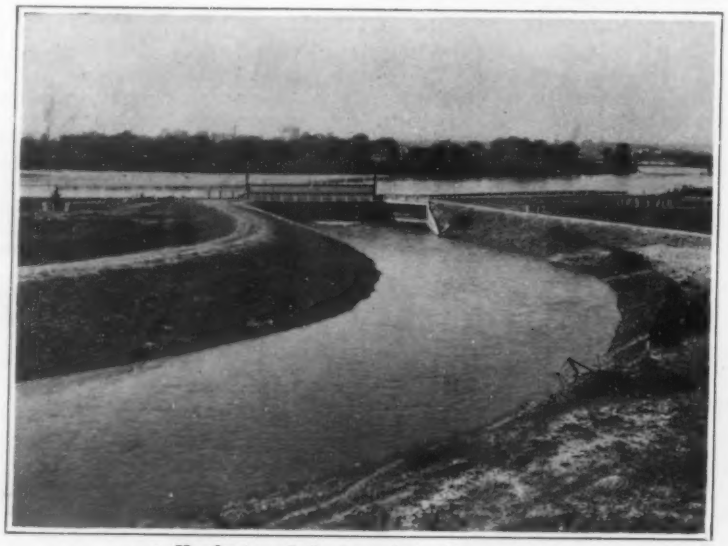
This dam was built across the Bow River in order to supply water for the eastern irrigation section, which has an area of 1,156,224 acres, but of which only 440,000 acres are to be made irrigable. Just above the site of the dam the Bow River makes a long bend in the shape of a horseshoe. The banks on the outer side are high and massive; but inside, the land, before the construction of the dam, sloped gradually down until they were scarcely higher than the level of the stream. Merely to have dammed the river would have resulted only in a diversion of the water into a new channel across the low-lying tongue of land within the horseshoe. For that reason a huge earthen embankment was first built across the foot of the horseshoe tongue before construction of the dam was commenced, consisting of a reinforced concrete spillway in the original river channel.

The spillway is of the Ambursen type, consisting of a heavy floor built upon the bed of the river, with suitable cut-off walls at its upstream and downstream edges; and upon this floor are erected parallel buttresses of substantially triangular outline, with a slope to the upstream edge of about 45 degrees. The deck is formed of concrete slabs cast on brackets projecting from the faces of the buttresses. This deck terminates at the top of the buttresses in a curved crest and passes off the downstream side in the form of an apron, curving to correspond as nearly as possible to the path of the over-flood waters. The structure is 720 feet long between abutments, with a maximum height of 40 feet to the overflow crest, above which eleven feet of water are retained by twenty-four sluice gates, operated by electricity. Rising from each alternate buttress, and separating the gates, are piers carrying a road bridge.

The earthen embankment is some 7,000 feet in length, extending from the south end of the spillway until it meets and merges with the sloping ground running down to the river. At its highest point it is 350 feet wide at the base and contains about 1,000,000 cubic yards of earth. The spillway contains some 40,000 cubic yards of concrete and 2,500,000 pounds of reinforcing steel. Construction on both parts was begun in the summer of 1910.

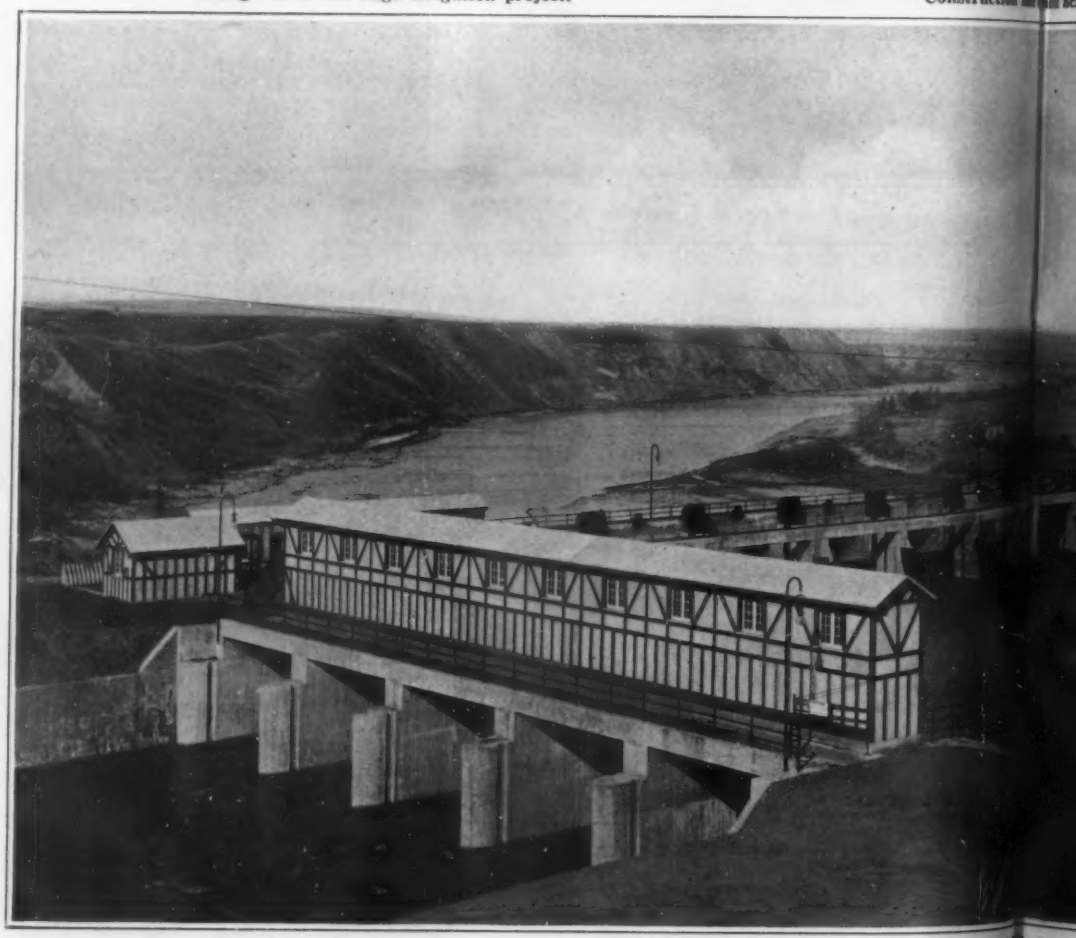
At the north side of the spillway, and at right angles to it, are located the headgates of the main canal by which the system is served. The elevation of the sills of these headgates is 35 feet above the original low water level of the Bow River, and above the sills are the 11 feet of water retained by the gates, making the total height that the water has been raised 46 feet. The headgates consist of five openings, each of 20 feet, with electrically operated sluice gates, and control a discharge of 3,800 cubic feet of water per second into the main canal.

From the headgates, the main canal leads to a point about five miles away, where an earth dam 1,280 feet long and 35 feet high is built across the valley to form a tail pool from which the branch, or secondary, canals are fed. There are two of these, the North Branch and the East Branch. The first follows the west flank of a deep valley known as the Crawling Valley, then runs north, and after throwing off numerous branches and becoming smaller, tails out into the Red Deer River. The East Branch, serving an immense area and feeding a large number of smaller canals, discharges into an artificial reservoir, about forty-five miles away, which has been formed by a number of earth dams in a depression of the Little Rolling Hills. The largest of these dams is about 2,000 feet long and about 30 feet high. The storage capacity of this reservoir is about 185,000 acre-feet. From all these secondary canals, in all parts of the system, distributing ditches lead to the farms within the project, from which the farmer will draw water for his farm in his own ditches. In all there are 2,500 miles of canals and ditches. The construction of the dam and canals took almost four years and cost $17,000,000. In all over 20,000,000 cubic feet of earth were removed in the building of the project.



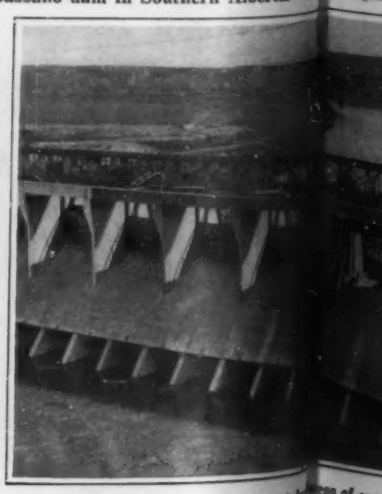
Headgates of the huge irrigation project.

Construction line and ac



Bassano dam in Southern Alberta. A

Waters of the Bow River pouring through the sluice gates.



The great d

The Current Supplement

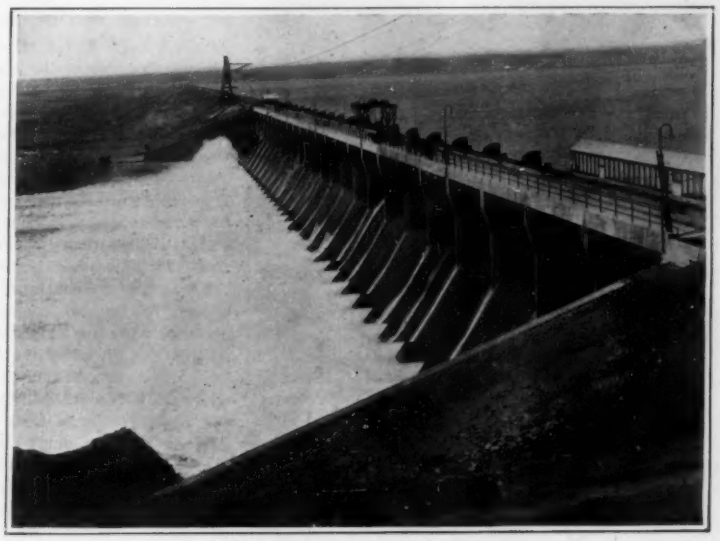
THE telephone has proved to be one of the most useful of the many modern inventions that are being utilized in the war, and indeed the large bodies of men, scattered over great distances, composing modern armies could hardly be organized and managed without this indispensable instrument, which has truly been called the nervous system of the army. The current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2072, for September 18th, 1915, has a most interesting story about the telephone in the German army, telling how the lines are strung and how they are used. There are a number of excellent illustrations accompanying the article. The development of the atomic theory has

eate Irrigation Project

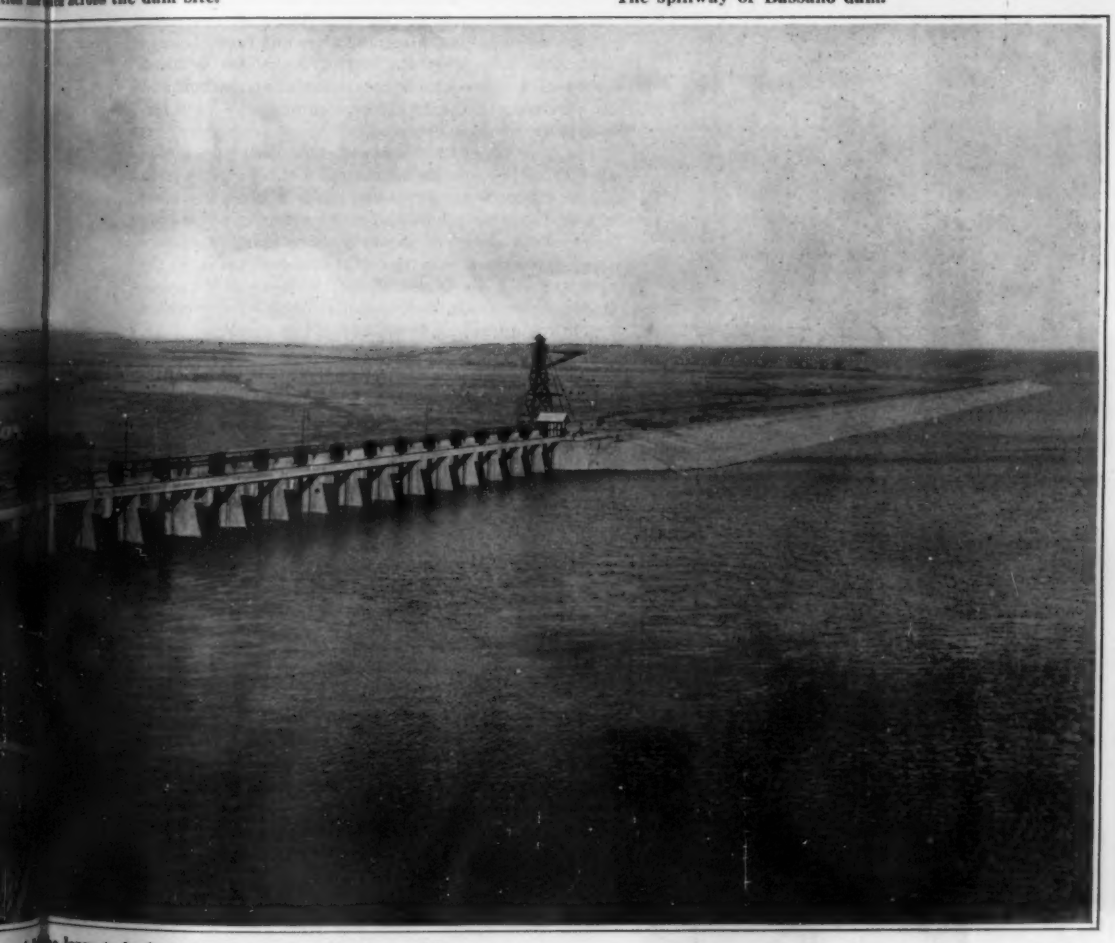
rn Alfa, Will Irrigate 440,000 Acres

By Z. Black

tion line ied across the dam site.

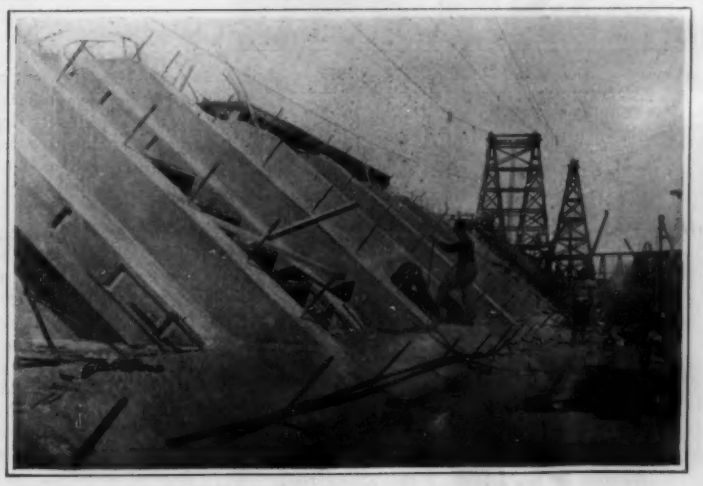


The spillway of Bassano dam.



e largest single irrigation project in the world.

ess of construction.



Forming the massive buttresses.

resulted in vast changes not only in chemistry, but in physics as well, and the disquisition on the subject in this issue of the SUPPLEMENT adds much to our information. War and the School tells in description and pictures how the interest of German school children in the war is stimulated. Speculation on the probable age of the earth continues, and undoubtedly is a subject of importance. There is a short discussion in defense of estimate, with some comments thereon. Everyone is familiar with motion pictures, but we frequently do not see what we think we see. The art of "tricking the senses," and various methods by which this is accomplished is contained in an interesting illustrated article in this issue. Artificial light, such as we are familiar with, of whatever description, is dependent on temperature radiation; but the question has arisen whether light cannot be produced by other means, that is cold light. This is the subject discussed in one of the current articles. Some points on the progress made in recent years in illumination, and the possibilities of the future are considered in "Your Lighting Bill in 1925." Most people have noticed the delicate, and often decorative tracings left on the sand of the seashore by the retreating waves, and they may be interested to read an investigation that has been made on the subject. It is extensively illustrated by actual photographs. The valuable article on the measurement of the distances of the stars is concluded. The Antecedents of the Study of Character and Temperament gives an interesting review of primitive mechanical theories and the evolution of physiology.

How Excitement Relieves Fatigue

EVERYONE knows from his own experience how intense excitement or alarm may act as a powerful stimulus to a jaded body, calling forth unsuspected stores of energy. This explains not only some seemingly miraculous exploits in rescues from fire, drowning or other sudden perils, but also some of the heroic deeds so common in war. The scientific reason for these sudden outbursts of energy from an apparently exhausted body is set forth in an article contributed by Prof. Jakobi to the *Münchener Medizinische Wochenschrift* and quoted in the April-May number of the *Naturwissenschaftliche Umschau*, a supplement of the *Chemiker Zeitung* (Berlin), June 4th.

Prof. Jakobi observes that a very high degree of fatigue, such as is caused by a long march, continued hard labor, making intrenchments, etc., is commonly, but incorrectly, called exhaustion. This state of incapacity for exertion, he says, is better defined as an extreme degree of fatigue, which may indeed lead to complete exhaustion. He says:

"This high degree of fatigue is due to the fact that strenuous and continued solution of energy in a muscle results in an alteration taking place in the blood-vessels which supply it, and correspondingly in the current of blood supplied. By reason of this the metabolic processes in the muscle (and moreover, those of more distant organs and even of the nervous apparatus) are influenced in such wise that it becomes increasingly difficult for the body to make use of the energy-producing material on hand, even though such material be very plentiful.

"Now it is a well-known fact that by imbibing preparations of the group of substances which contain caffein, such as coffee, tea, chocolate, coca cola, etc., the first symptoms of fatigue can be successfully overcome. This favorable influence rests partly in the fact that these substances facilitate the power of the muscle to react to the impulse of innervation. . . . It is known, however, that caffein itself, as well as the etheric oils in tea and the empyreumatic products in the decoction of roasted coffee, stimulate the nervous center controlling the blood-vessels (Gefässzentrum), so that in this way the relaxation of the arteries is diminished and there results a favorable distribution of blood. Herein lies the reason for the lavish use by our troops of coffee, tea, coca cola, and chocolate. But such preparations are incapable of relieving severe fatigue—the so-called 'exhaustion,' for a very long time."

But Nature herself, Prof. Jakobi points out, has made a very wonderful provision for influencing the blood-vessels so as to produce increased blood-pressures, with corresponding influx of energy, under conditions of exceptional danger, which imperil life itself.

"It is a well-known circumstance that the powerful psychic stimuli of the emotions of fear and anxiety, as well as great excitement or enthusiasm, render even a seriously fatigued person capable of uncommonly great exertion, i. e., expenditure of energy, and that, too, for a surprisingly long time. This is readily explained by the fact that a mental impression received by the cerebrum may operate as an extraordinarily effective and extensive stimulus to the whole vascular system. In this way we may account for the extraordinary outputs of energy which take place in war, far surpassing ordinary efforts, both in amount and in duration, as the effect of mental stimulus acting directly upon the blood-vessels which supply the muscles."

Throwing vs. Batting a Tennis Ball

By Dwight Douglass

CALIFORNIA PROFESSIONAL TENNIS INSTRUCTOR.

WHEN played by experts, tennis is a game of such high requirements as to skill, in the infinite variations of type of stroke, angle of return, and strategy, all performed by instinct because there is not time for the conscious mind to act, that the present author has finally become convinced of the importance of making public a basic principle in tennis, which up to the present seems to have escaped recognition altogether, except as he has brought it out in his lectures and teaching. It is used constantly, but is not developed nearly to its capacity because its adoption is unconscious, is found only among the experts, and is adopted by them only when, by long practice, they find themselves obliged to discard the methods they learned as beginners.

And yet, though unrecognized, the mechanical principle involved is of infinitely greater importance than any matter of grips, bodily posture, or other details which have been hotly discussed for years; for it relates to the one universal act in tennis—the contact between ball and racket. That is fundamental. All else is incidental.

So fundamental is it, and yet so contrary to the usual belief, that the author regrets the limitation in the length of the present article, which forbids more than the merest statement of the principle involved, and prevents the presentation of the results of his thorough study of the subject, some of which would undoubtedly answer questions that naturally arise when a new principle is formulated. Such discussion must be reserved for other articles.

The delusion is prevalent that when a racket hits a ball it knocks the ball by an instantaneous hit similar to that with which a baseball is knocked by a baseball bat. The racket is flat and somewhat elastic and the ball is made as elastic as practicable, so the superficial and natural impression, upon which advice to beginners is based, is that the hit and rebound are instantaneous and from one spot on the racket, and that the speed is due to elasticity, helped by the force of the blow, which force is applied from behind the blow, and which acts directly in the line in which the ball is to be knocked.

If the human eye were quicker, or the contact slower, the fallacy of this supposition would be apparent, and the ten years of hard practice now considered essential in developing a first-class player would be materially reduced. For it is a long, hard process to change early habits, and habit is in absolute control in the execution of tennis strokes. A man cannot play a winning game if he thinks about his strokes.

With some ladies and some beginners the ball may sometimes be hit thus flat. But when manipulated by experts the racket assumes a throwing function in which centrifugal force plays a large part, and in which the propulsion of the ball comes from an application of force at a distinct angle to the line of ball-flight instead of directly along that line, the ball being thrown forward from what is in effect a concave curved surface presented to the ball by the racket as the racket swings forward and around, much as a lacrosse ball is thrown from a lacrosse stick. The speed possibilities inherent in this principle are enormous, but are practically undeveloped by the average player to-day, whose "stroking" of the ball is to make it spin, and is not thought of as a direct source of tremendous propulsive power.

The racket is drawn back before hitting the ball, and is brought forward in a way which would knock the ball straight ahead without any side-spin whatever if the natural pivoting effect exerted on the swing by the shoulder could be overcome, and if the hand were pushed forward as fast as the head of the racket goes forward, and if the racket were exactly at right angles to the line of ball-flight.

The advice to attempt to do precisely this is even yet current, and as a result there is general surprise and even criticism of "form" when a master like Norman Brookes comes along and deliberately breaks these rules into fine pieces, producing marvelously efficient results by his skillful racket manipulation upon the principle I am here formulating, and exciting wonder at the speed he produces with a racket strung with gut much heavier than the light "tournament" gut considered necessary by those who follow the conventional method.

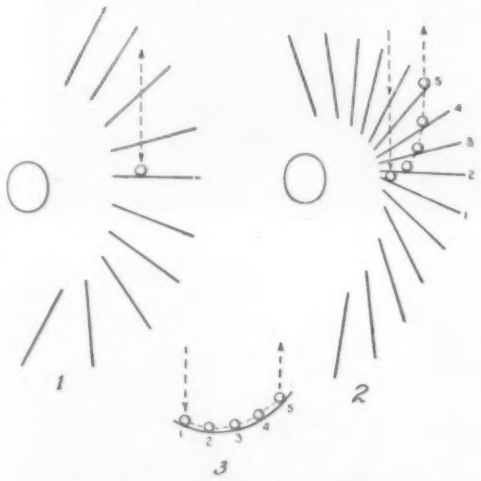
Then little William Johnston comes along, and with an abnormally small wrist drives the ball at a speed that excites still more wonder. And McLoughlin says of Williams, commenting on the finish of his swing close across and in front of his body: "One wonders on seeing such a finish where Williams gets the speed in his drives."

Neither Brookes, nor Johnston, nor Williams, nor many others the author has seen play, could get their exceptional speed if they hit the ball flat, or failed to use the principle of the centrifugal curve-throw which they have instinctively adopted.

By courtesy of the *American Lawn Tennis*

R. Norris Williams, 2nd, making a forehand drive.

The white streak shows the progress of the ball as it is swept across the racket.

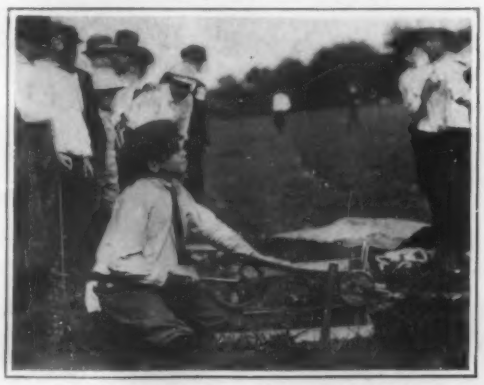


Successive positions of the racket and ball.

1, present idea of what takes place when a tennis ball is hit; 2, what actually takes place with the skillful stroking of the best players of to-day; 3, curve formed by projection of racket positions without forward movement.

Noting the angle of altitude.

Measuring the pull of a kite.



Hauling in the kite on a measuring reel.

Take, to illustrate the principle, one of an infinite number of strokes—a straight, horizontal forehand drive. Top is generally added, but ignoring it here simplifies the explanation.

When a racket is drawn back to acquire momentum, and is then swung forward toward the ball, the head of the racket trails behind the handle. If the ball is met while the head is thus behind, the ball slides onto the racket without shock, two things contributing to this result. One is the angle to the line of ball-flight, and the other is the simultaneous drawing motion exerted on the racket handle, not directly forward, but across the line of ball-flight. The latter element is indispensable, for the inclined angle, if unaccompanied by the draw, would simply make the ball glance off the racket. This premature rebound must be avoided, or the powerful force inherent in the racket and designed for the ball will be wasted, and decreased speed with increased wildness will be the result.

The swing is continued, the racket head swinging around by its own momentum, aided by some hand pressure with the wrist flexible, and finally reaching a position far ahead of the hand. The racket-head, having started from behind the hand and finished ahead of the hand, it is plain that the ball which was drawn onto the racket without shock has run around what is in effect a concave curved surface, due entirely to the motion of the racket; and that the ball is finally thrown forward toward the net, its momentum not being stopped with a shock and new momentum applied to it all in one single instantaneous act, but that on the contrary the original velocity is retained and accelerated on the trip around the curve. The main heave of the body, giving a powerful pull along the arms and racket, comes just at the time when the end of the racket is tilted far forward and contains considerable momentum, and the resultant of the two forces propels the ball forward with tremendous speed.

It is regrettable that space forbids even mentioning some of the advantages of the curve-throw. The main difficulty with a flat hit is the shock it gives the hand in a hard-hitting game; and no tournament player can ignore a day-after-day pounding on his hand of a force equal, at the high velocities of the modern game, to the pounding of a good-sized sledge hammer. Nor can he ignore the wildness due to the twisting of the racket which would inevitably result from this shock.

The centrifugal curve-throw overcomes this, and on the offensive side it presents a method of applying the strength of the human body, which is as much greater than that employed in hitting flatly, as a pull along a tug-of-war rope is greater than a slap with the open hand applied at arms length from the body; and which sends the ball as much faster than a flat hit would, as the centrifugal curve-throw of a baseball outfielder is faster than a similar force exerted on the same ball with a putting-the-shot motion of the arm.

Measuring the Altitude of a Kite

THE public school system of Cincinnati has been giving a great deal of attention, latterly, to the matter of the retarded child, the boy and the girl who are not physically dull, but who simply seem to lack initiative; who, in the words of the teacher, need something to stir them up. All manner of novel methods and forms of procedure are being adopted or tried to the purpose, and, among others, not so long since, Prof. D. K. Hiett arranged for a great kite-flying contest between these youngsters. Boys must make their own kites, and prizes were offered for the kite flying highest, the kite staying longest in air, and the like.

This put the boys upon their mettle, and, on the day of the great contest, there was some giant kite-flying. Then, of a sudden, the judges found themselves in a dilemma. They had presumed to measure a kite's actual height in air by the length of string that was run out from the reel; but they had overlooked the fact that a kite might run out no end of cord, and yet not rise as high as some other.

Then Prof. Hiett came to the rescue with the invention of an altitude finder. The apparatus consists of a plain board, on which a quarter circle is laid out and divided into degrees. At the center of this quadrant is pinned a loose arm, carrying a set of globe sights and a pointer. A common carpenter level is attached to the side of the instrument.

When in use, now, this instrument is held level and a sight on the kite is taken, the angle being read at the pointer. The string is then pulled in and wound around a set of stakes, four in all, placed in the ground, fifty feet apart, thus giving its length, of course.

The altitude is then found by multiplying the string length by the sine of the angle.

For example, a kite is flying at an angle of sixteen degrees and carries 2,400 feet of string. Then: Line 16 degrees = 0.2756. Altitude, 2,400. Result 661.4400 feet.

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

A Midget Motor Vehicle

DURING the past two years there have been various movements to introduce light-weight motor-driven vehicles ranging all the way from the cyclecar to the motor wheel, but the smallest self-contained vehicle that has yet been brought out is the "mon-auto," shown in the illustration. This is a complete motorcycle and incorporates a number of ingenious arrangements. The wheels are 14 inches in diameter, and the 2⅝ by 3 four-cycle motor is rated at 2½ horse-power, which it is claimed is capable of driving the vehicle at a speed of 25 miles an hour. The frame is decidedly simple, consisting only of a length of large-sized tubing, which acts as a tank as well as forming a very rigid frame. The total length of the machine is 48 inches, with a width of 9 inches and a height of 18 inches, just about that of an ordinary chair.

A most original feature of this midget machine is the simplicity of its control. The handle bars, besides doing the steering, have a swinging motion forward and back, and are so connected with the throttle and clutch that a backward movement of the handle bar closes the throttle, throws out the clutch and applies the brake, while a forward movement of the bar reverses these operations. Moreover, the further forward the bar is pushed the faster the machine will run. These movements of the bar are instinctively made by the rider, so that it is claimed that anyone can safely ride the machine with no previous experience.

It is apparently not expected that this machine will appeal to the pleasure rider as much as to the busy business man who must get around without loss of time. Its convenience for military operations is also pointed out, for its light weight, 45 pounds, allows of its being picked up and carried over when a stream or other unridable obstacle is met. This light weight also permits it to be readily carried into the house, instead of having to leave it standing in the street, while its compact size enables it to be stored most anywhere.

Gas-steam Radiators

STEAM or hot water radiators have been accepted as the most convenient means for heating rooms, but in some cases the expense of a boiler and extensive piping is prohibitive, and in others, especially in old buildings, it is difficult to install such a system. Here an individual unit would be extremely desirable, and this is supplied in a radiator that is heated by gas, either artificial or natural, as shown in the accompanying illustration. In general appearance this radiator is similar to the ordinary steam apparatus, but combined with it, in the base, is an inclosed gas burner and combustion chamber, which may be vented through the wall into the open air. A few quarts of water are occasionally poured into the radiator through an opening provided for the purpose, and when the gas burner is lighted this water is converted into steam. It will be noted in the cut that the two end sections of the radiator overhang the central heated portion, and these act as condensers for collecting and returning the water to the heater base. At the left of the picture is seen the gas connection and regulating device, which consists of an adjustable thermostat valve that can be set for any pressure between five and fifteen pounds. This valve is operated by means of a connection to the adjoining condenser section, and when the steam reaches the desired pressure the thermostat works to close the gas valve to a point that will just maintain the pressure. At the upper left hand corner of the radiator is seen an automatic air relief valve, of the usual kind, and on the right is a safety valve. As each radiator is an independent individual unit requiring only a single gas connection, and can be started up at any time as desired, the device would appear to be remarkably convenient in many situations.

Chest Telephone for Aeroplane Pilots

THE rush of the wind and the deafening roar of the propeller discourage conversation between the pilot and the passenger of an aeroplane, hence the invention of a special telephone equipment illustrated herewith.

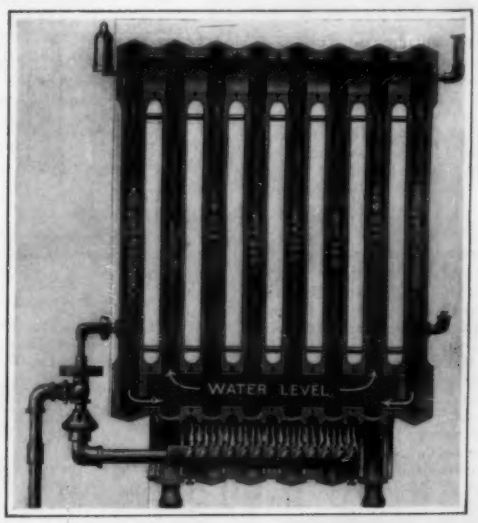
The apparatus consists of two double-head telephone receivers and two special types of chest transmitters. The receivers are held against the ears by a spring head band so that practically all of the disturbing noises are excluded.

The transmitters are provided with soft rubber caps strapped to the chest at a point below the collarbone and above the third rib. In speaking, the chest muscles

A handy runabout for war or peace.

transmit the voice vibrations to the transmitter, thus enabling a telephone conversation to be carried on between the two occupants of the aeroplane.

The receivers and transmitters are connected by suitable cords which terminate in a small plug. As the



A unit gas-heated radiator.

aviator or passenger takes his seat, the plug is inserted in a jack mounted in the framework of the aeroplane. One of these jacks is provided for each occupant. The battery required consists of three standard telephone dry batteries, which will provide continuous service for

How the chest telephone is worn.

100 hours without any appreciable loss of transmission quality.

Telephones are indispensable in the military branch of aerial work, modern aerial warfare having made it necessary that aviator and passenger be in communication at all times.

Edward B. Moore

A MAN of remarkable experience as an official in the Patent Office and as a negotiator of patent treaties in foreign countries, died on September 6th, at Washington, D. C. For nearly fifty years Mr. Edward B. Moore was solely an employee of the Government. First, a United States Senate page and later an assistant examiner in the Patent Office; then principal examiner until appointed an assistant commissioner; and finally in 1907 he became the commissioner, until 1913, when he entered as a member the patent law firm of Moore & Clark of Washington. His ability secured for him notable successes in various important and difficult diplomatic missions to other countries, wherein he concluded arrangements for safe-guarding American patents. In 1900 he acted in Paris as special commissioner to the great Exposition, and in 1908 was our delegate to the International Patent Congress at Stockholm. In the latter year he negotiated the important work of completing the present treaty with Germany in reference to the non-working of patents in that country by American investors and manufacturers. In 1909 he represented the United States on a mission to Norway, Denmark, Sweden, Russia, Austria, France, Italy, and Belgium, to arrange for the safe-guarding of American patents in those countries. Soon after this he prepared the patent regulations and observances now in force in South America. Mr. Moore served in other prominent positions for the Government, and was a member of numerous societies and clubs. He died at the age of sixty-four.

Some Adjudicated Patents

THE Lane design patent, No. 37,501, for a piano case was held valid and infringed in Bush & Lane Piano Co. v. Becker Brothers; the Barnard patent, No. 580,151, for a fluid distributor was held not infringed in Barnard v. Deming Company; the Pumphrey patent, No. 665,977, for a coin operated mechanism, was held not infringed as to claims 5 and 6, and claim 24, if valid, was held not infringed in Autosales Gum and Chocolate Company v. Ryeve Specialty Works; the Stauff patent, No. 666,711, for method of dessicating milk, etc., was held not anticipated and that it discloses patentable invention and is entitled to a liberal construction and that it is infringed in Merrill-Soule Company v. Powdered Milk Company of America. The same patent is held valid and infringed in Merrill-Soule Company v. Natural Dry Milk Company. The Ferguson and Benthall patent, No. 808,442, for a peanut picker, and the Benthall patent, No. 891,401, for a peanut stemmer, were both held not anticipated, valid and infringed, and the Jones patent, No. 908,271, for a peanut picker and stemmer, was held void for anticipation by prior use and also not infringed in Benthall Machine Company v. National Machine Corporation. The Shook patent, No. 993,723, for a water heater, was held void on the ground that the patentee was not the original and first inventor, in Pittsburg Water Heater Company v. Beler Water Heater Company.

Dr. Marcus Benjamin, editor of the United States National Museum in Washington, D. C., has received a silver medal for his exhibit of portraits and autograph letters of the presidents of the American Association for the Advancement of Science. It is interesting to note that Dr. Benjamin began this collection when the American Association for the Advancement of Science met in New York in 1887, when he furnished sketches of Prof. E. S. Morse, the retiring president of that year and of Dr. S. P. Langley, the presiding officer of the New York meeting, and since then he has furnished annually to the SCIENTIFIC AMERICAN sketches with portraits of the presidents of the American Association. This collection, which is unique, begins with President Redfield, who presided over the Philadelphia meeting in 1848, and is completed with the portrait of Director W. W. Campbell, who presided over the meeting held in San Francisco during August 2nd to August 7th of this year. Autograph letters, most of which have been addressed to Dr. Benjamin, accompany each portrait.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

COMBINED SHIRT AND UNION SUIT.—F. E. SEEMERE, 752 Caldwell Ave., Bronx, N. Y., N. Y. The object here is to provide a combined shirt and union suit arranged to permit the user to quickly convert the garment from an ordinary shirt to a union suit or *vice versa*, and while the garment is in position on the wearer's body.

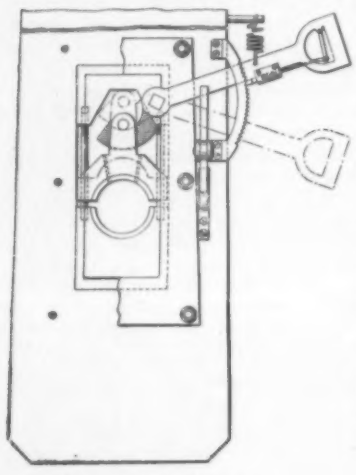
Of Interest to Farmers.

HAY BALE TYING DEVICE.—B. G. PATTERSON, 1436 W. 14th St., Oklahoma, Okla. This invention relates to improvements in automatic tying devices for bales of hay to be used in connection with or as an attachment to a hay baling device. It provides a device which will automatically tie the bales as they are being formed, thereby obviating the necessity of employing hand labor for this purpose.

BRACING DEVICE FOR SILOS.—T. M. HAMILTON, R. F. D. No. 1, Fairfax, Va. The device is particularly designed for use with wooden silos of the type in which a series of staves is held together by retaining bands on the outside of the silo after the manner of the so-called barrel construction.

Of General Interest.

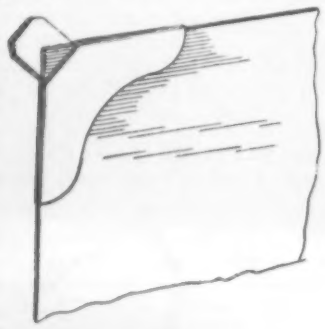
PITMAN BOXING.—J. CHURCHILL, 1211 California Ave., Bakersfield, Cal. The improvement is in boxings as used on pitmen for well boring, and the inventor's object is to provide an inexpensive and reliable bearing



PITMAN BOXING.

which will automatically take up the wear between the wrist pin and the bearing blocks, and will make a quickly demountable, accurate bearing.

PAPER FASTENING.—O. W. NIEDOMANSKI, 721 Rock Creek Road, N.W., Washington, D. C. By means of this improvement the inventor provides a simple and inexpensive fastener which will effectively hold a plurality of paper sheets without the necessity of perforating,



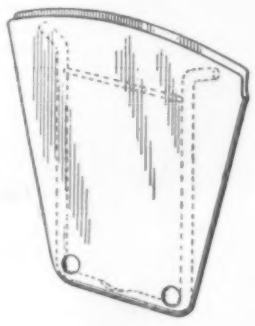
PAPER FASTENING.

punching or otherwise mutilating such sheets; which will readily receive the corners of the papers to be fastened and guide the same into the desired position, and will, by the single operation of bending a projection, firmly connect the papers together.

HAND BAG.—A. SPIRO, 204 W. 111th St., New York, N. Y. This invention provides a hand bag with means for preventing the undetected opening thereof; provides means for protecting the fittings of the bag from filth or dirty accumulations; provides a change receptacle disposed to afford easy access thereto; and provides a bag with a pocket receptacle independent of the main body of the bag or of the change receptacle mounted thereon.

DENTAL VULCANIZING FLASK.—E. A. HEWES, Duncraig, Waverly Road, Eskbank, Dalkeith, Midlothian, Scotland. This invention relates to a dentist's flask for vulcanizing dentures in a plaster of Paris investment, and has for its object to prevent breakage or distortion of the plaster of Paris investment when heat is applied thereto or when the pressure at which vulcanization is effected is suddenly reduced.

DRINKING CUP.—C. H. FREEBURG, 113 W. 3rd St., Erie, Pa. The invention relates to drinking cups, of a pocket or collapsible type, and one of the main objects thereof is to provide a permanent, sanitary, compact, and com-



DRINKING CUP.

paratively inexpensive cup which may be carried on the person for use at any time, and particularly in such States or localities where common drinking cups have been prohibited by law.

Heating and Lighting.

HEATER.—D. W. ATKINS, 1020 W. 4th St., Marion, Ind. The invention relates to heating apparatus, and more particularly to a gas heater, the construction of which renders it adaptable for use as a stove or a hot air furnace. The primary object is the provision of a gas heater which is effective in producing a maximum of heat, and one which may be manufactured at a minimum cost.

EMERGENCY GAS CUT-OFF.—G. R. NIXON, 59 Hawthorne Ave., Pittsfield, Mass. This invention relates to gates or valves for use in connection with gas pipes or the like, and has particular reference to a cut-off for gas between the city supply and a building, the device being adapted to be operated to cut off the flow of gas in emergencies such, for instance, as in the event of fire or the like in the building.

Household Utilities.

BREAD SPONGE AND DOUGH RAISER.—J. COBB, 65 Humboldt Ave., Jamaica, Queens, N. Y., N. Y. The invention relates to household and culinary appliances and has particular reference to an assemblage of containers adapted in the main to nest within one another and adapted for many uses. It is useful particularly in rural or other homes which are frequently not thoroughly heated in cold weather, for the purpose of setting and raising bread sponge or dough, a container being arranged to receive the commodity to be treated.

Machines and Mechanical Devices.

CAPPING MACHINE.—J. C. PEPPERS, Y. M. C. A., Beaumont, Tex. The improvement provides a machine designed for placing friction caps or covers of cans containing canned material, and for sealing the covers or caps in place on the cans, and arranged to be capable of use with cans of varying size.

MATRIX CLEANER.—E. L. KOKANOUR, Rogers, Ark. This machine is especially adapted for cleaning and polishing the matrices used in linotype and intertype typesetting machines, wherein a supporting table is provided having rotating cleaning and polishing mechanisms over which the matrices are pressed in succession until cleaned, and wherein stacking mechanism is provided for stacking the matrices after they are cleaned.

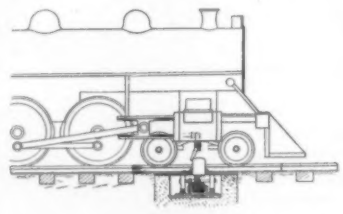
TENSION CONTROL.—M. C. HATTON, Upland, Cal. The invention relates to tension devices for controlling the winding or unwinding of wire or cable from reels or bobbins whereby the wire on the reel will not become slack and will not tangle. The device is automatic in its action and can be adjusted to control its action within the desired tension limits.

MOVING PICTURE MACHINE.—C. A. BUTLER. Address L. L. Westfall, Paulsen Bld'g., Spokane, Wash. This invention provides a construction of frame and associated parts for moving the intermittent sprocket of the machine up and down without interfering with the time of the shutter with relation to the lens or with the intermittent movement of the sprocket.

Railways and Their Accessories.

SWITCH TIE PLATE.—D. HARRINGTON, 1179 Broad St., Newark, N. J. The purpose of this invention is to provide a tie plate, arranged to prevent the main rail from spreading by providing a firm support for the inner edge of the rail base and without obstructing the free movement of the switch rail.

TRAIN STOP.—J. G. BRINSON, Idaho Falls, Idaho. This invention relates to train stops; that is, to mechanism used for automatically stopping a train when the latter would otherwise be exposed to danger. More particularly



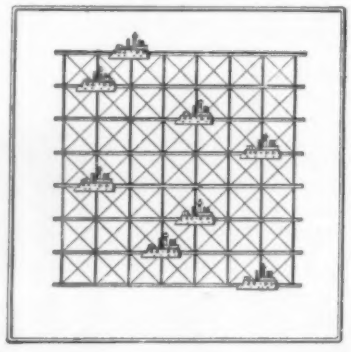
TRAIN STOP.

stated, it relates to train stops of the kind operated by electricity and controllable automatically by a predetermined condition of one or more electric currents.

Pertaining to Recreation.

GAME APPARATUS.—J. W. HAMMOND and PERLIE M. HAMMOND. Address Mr. and Mrs. J. W. Hammond, 3214 Oakland Ave., Minneapolis, Minn. In this case the game apparatus has been devised and constructed along scientific lines with a view of testing the sight, calculating faculties and skill of the player, and removing possible advantages arising rather from good luck than from clever playing.

PUZZLE.—A. REIBSTEIN, 309 E. 9th St., New York, N. Y. In order to accomplish the purpose of this invention use is made of parallel guideways equal distances apart, buttons, one for each guideway, and slidable thereon, and sighting means intersecting the said guide-

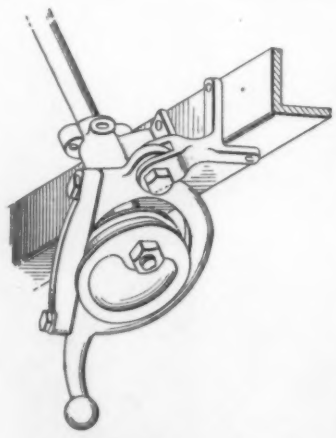


PUZZLE.

ways at a right angle and diagonally to permit of positioning the said buttons on their guideways so that no two buttons are in alinement along the said sighting means. It is arranged to afford an enjoyable pastime and to require considerable skill for solving the problem.

Pertaining to Vehicles.

AUTOMOBILE STEERING DEVICE.—N. S. MATSON, Box 435, Fargo, N. D. The invention is an improvement in automobile steering devices, and has for its object to provide a device of this character, especially adapted for

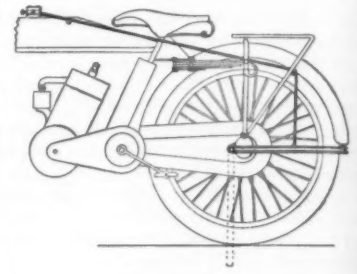


AUTOMOBILE STEERING DEVICE.

use with the Ford automobile, and arranged to reduce the leverage on the steering post and to permit a part of the steering mechanism now in use to be omitted, and wherein the lost motion between the steering wheel and the spindles is eliminated.

WASHING DEVICE FOR AUTOMOBILES OR LIKE VEHICLES.—H. T. FORD, care of C. T. Ford, Central Valley, N. Y. The device may be adapted for various uses where it is desired to first apply a stream of water to an article to be cleansed to loosen the surface dirt and foreign matter and then to remove the same by means of a sponge or mop which is continuously supplied with fresh clear water or cleansing fluid so that the efficient cleaning of the object is permissible in a convenient manner.

VEHICLE SUPPORT.—JEFFERSON M. HERRINGTON, 916 E. Strong St., Pensacola, Fla. The invention relates to improvements in supports for motorcycles and bicycles and other vehicles, and its objects, among others, are to provide an efficient and reliable device of this character by which the rider is enabled to op-



VEHICLE SUPPORT.

erate the support without getting off of the machine, such device embodying few parts, those easily assembled, cheap of manufacture and not liable to get out of order. Mr. Herrington has obtained a patent on this vehicle support in Canada.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

HOW TO MAKE GOOD. A Business Man's Message on Commercial Character-Building, the Only Success Insurance. By Alfred T. Hemingway. Kansas City, Missouri: Efficiency-Building, 1915. 12mo.; 86 pp.

A Missouri business man offers some pithy advice to youths on the essentials of success. The principles of character-building here reformulated were, of course, established ages ago, but in their application to commercial activities and achievements the author manages to give his expression a freshness and force that cannot but leave their stamp upon the impressionable mind of youth.

THE MARINE MOTOR. By Frank W. Sterling. New York: Outing Publishing Company, 1915. 12mo.; 136 pp.; illustrated. Price, 70 cents net.

Lieut. Sterling discusses fuel, types and cycles, constructional details, carburetion, ignition, lubrication and all the other essentials that go to the make-up and operation of the modern marine motor. The author succeeds in presenting the fundamentals in so brief and simple yet so adequate a form, that the reader quickly acquires a true insight into constructive practice and efficient operation. He is taught to find and to remedy his own motor troubles, and the final chapter devoted to engines makes him acquainted in detail with various types.

THE NEW INFINITE AND THE OLD THEOLOGY. By Cassius J. Keyser, Ph.D., LL.D. New York: Yale University Press, 1915. 12mo.; 117 pp. Price, 75 cents net.

Prof. Keyser believes that Theology is to be rehabilitated upon more scientific bases, and that Mathematics is destined to play a leading part in her restoration to the throne. The author regards rational theology as manifestation of a divine energy, at once human faculty and cosmic force, deeper than will. Although his aim has been to illuminate the whole subject by the light of modern mathematical ideas and methods, his presentation does not demand of the reader any specialized knowledge. A fair share of the mathematical spirit, which Prof. Keyser concedes to every logical thinker, will enable almost anyone to grasp the reasoning of his advocation. In his explanation of the scientific meaning of the term infinite, some most interesting paradoxes are developed. Only in the infinities of science may our more material vision glimpse a justification of theology's infinite ideal. Through these mazes, the author guides us with firm hand and encouraging voice.

A Large Induction Coil of Novel Design

(*Concluded from page 250.*)

sess valuable properties once they are understood.

The inventor of the new coil has not yet revealed the secret of the detail of design and construction and method of operation, beyond permitting its use for the taking of Roentgen ray photographs and fluoroscopic examination and application of high tension currents, but so far as can be determined by a superficial examination of the apparatus in the laboratory it produces currents by a peculiar process of tuning and selection whereby electric waves of the highest pitch can be secured by picking out the overtones of oscillatory vibrations of the highest frequency.

With a high tension current thus produced an X-ray tube may be excited with a minimum amount of energy, and with the ease of regulation possible almost any form of tube can be employed. The inventor in his work prefers a tube of high exhaustion, and once the current is regulated a constant emission of rays can be maintained, particularly available for Roentgenographic work. The inventor shows a number of photographs of extraordinary clarity made with the new apparatus, and especially one of a skull made with less than one milliampere of current at an estimated tension of 1,500,000 volts showed a sharpness of shade and outline that was particularly noticeable and compared favorably with the best Roentgenographic work under ordinary conditions where a tube would be excited by using a current strength as high as from 25 to 50 milliamperes and with a tension of 100,000 to 150,000 volts. Naturally, to secure the proper capacities for use in producing the oscillatory currents in the resonance circuits there are a number of condensers, and seven different arrangements are available to get the adequate degree of resonance and intensification of the desired currents.

Working with any standard form of tube increased penetration for the X-rays is claimed, and furthermore, photographs can be made at a much greater distance than with any apparatus now available, and while the time of exposure has not been shortened or the definition increased to any marked degree, yet the photographs themselves can be made and the fluoroscopic examination conducted with greater convenience. Furthermore, the high tension currents can be regulated so as to secure a very steady emission of X-rays from the tube and, as stated, these rays are unique in that for them is claimed an absence of injurious effects, notably the familiar X-ray burns and the impairment of the operator. The inventor claims that exposure without protection will not result in injurious effects, and that he has held his hand directly in front of a tube in operation for hours at a time.

In addition to its use in Roentgenography this new apparatus affords a series of high tension currents available for the direct application of such currents to the human body. Just what can be done with such currents is more or less problematical to-day, but that they may possess therapeutic properties, which if properly understood may prove of great utility is quite possible. This new apparatus apparently presents a wider range of electric current than has been obtained hitherto by various forms of transformers, and with currents of a frequency and nature not hitherto available, the results to be attained after continued experiments will be awaited with interest.

A Thinking Machine, Planning and Theories.

(*Concluded from page 246.*)

tion of the muscle. Hence, a faint discharge from the brain to a muscle is followed by a sensory discharge from the muscle to the brain. We will name this the *theory of strain signals.*

As an alternative, we may assume that a faint motor discharge causes an amoeboid movement in a nerve junction or synapse at some point between the brain and the muscle. This movement, like a muscle contraction, sends back an afferent impulse. There would be a slight delay due to this synapse movement.

The theory for a train of thought of several steps is analogous to that of a routine performance such as we have discussed. Each muscle that is excited in turn gives *strain signals* to other muscles. The direction taken by the discharge may be determined by some purpose or desire signal that arouses certain channels by association.

If we may accept this very brief explanation of nervous development in thinking and learning to think, let us see if a memory gear can be made to correspond. We find that the compound machine as described will execute a performance requiring secondary counter signals, but no provision is made for the special case of *strain signals* which are given when a movement is incipient only. A further modification is needed.

A Thinking Machine.

Now there are several ways that could be followed to provide for strain signals from inhibited or incipient movements. We will briefly consider one method. For each transmitter exciting a given movement there is provided an auxiliary transmitter connected to the same key rod. All these auxiliary transmitters excite a movement in an auxiliary cylinder which operates another (auxiliary) key rod, controlling the movement that is to follow. It is plain that when the given movement is inhibited the auxiliary cylinder will pass along the signal for the later movement.

With this improvement, a compound memory gear could be arranged to give responses like those of a child learning to think. Let us suppose that our machine is so constructed that the movements of all auxiliary cylinders are concealed while other cylinder movements are exposed to view.

On consideration we see that when it has been duly trained by the right operations we have only to press the proper key, and after a certain time (during which a series of concealed movements is made), the proper response will come as in the case of a child that stops to think before it acts.

By way of comparison, think of a child that is asked to name the third letter of the alphabet. Perhaps he will silently count on his fingers and then say *C.* In common words, he will think before he answers. Of course, such behavior is due to previous training. Therefore, when our memory machine gives a response, due to concealed operations determined by previous training, we can fairly term it a thinking machine. Hence we may say our second modification of the memory gear, has given it the power of deliberating before it responds.

In conclusion we may say that the memory machine when modified by compounding and adding auxiliary cylinders, as we have indicated, gives promise of simulating the operations of intelligent behavior by responding to excitation with movements combined in groups or series as determined by experience. It promises also to perform like a creature that stops to think before acting.

In view of all this it will prove very profitable to the advancement of science to make a serious effort to determine what mental processes can be successfully imitated by the thinking machine.

A Million Chickens to an Acre

(*Concluded from page 247.*)

and then transferred to electric light, and still others that were started under electric light and then taken outdoors.

As far as the direct effect of the light is concerned I find no evidence that it makes any difference to the chicks. They can see in a very moderate amount of light, a 25-watt tungsten lamp being sufficient to illuminate a floor area of 100 square feet. This amount of light at 2 cents a kilowatt levies a tax of less than half a cent per broiler grown and is more than paid for in the fuel economy gained

from the altered form of building. The cost of light for a laying hen for a year would be paid for by two extra eggs in December.

The SCIENTIFIC AMERICAN has hitherto published accounts of the stimulation of chick growth by charging the air with high-frequency electricity. I am not prepared to pass judgment upon this work. Should it prove of merit, my plan, because of the great concentration in space, will be able to make the more economical use of such treatment.

My own efforts to "electrify" the chicken industry apply only to the prosaic uses of electricity for power and light. Nor do I even have theories regarding the therapeutic values of electric light baths. It is rather a plain matter of light to see by and power to run blowers and feed grinders and litter mixers and fertilizer mills.

As every poultryman knows, the most difficult month of the year in which to get eggs or rear young chicks is December, whereas the reverse is true of May and June. Even when the temperature is made right the winter chicks fail to thrive as they should.

The chicken goes to bed and gets up with the sun. This means that on a December night he must sleep fifteen hours without food. The chick's digestive system will empty itself in six or eight hours and the rest of the long winter night it is to run on a starvation basis.

On the other hand, for baby chicks plenty of sleep is important. The best mother hen is one that broods her chicks and gives them little daytime naps. As the chick wakes and sleeps by the coming and going of the light, the use of artificial light gives a complete control of the cycle of work and sleep and of eating and fasting. At the present writing I am giving my young chicks periods of six hours of day and six hours of night, or two chicken days in one natural one. I do not know that this is the best possible schedule, but the chicks thrive on it, providing that the diurnal cycle of nature is not the only one to which the chicken can adapt itself, and strongly indicating that there are superior cycles to be discovered and which doubtless vary with the age of the birds and the effect we wish to secure.

This complete command of the daily and the seasonal changes make practical the operation of the plant twenty-four hours a day, 365 days in the year. Both chicks and men can be worked in one or two shifts a day, one group working while the other sleeps. It means a 100 per cent load factor on the power supply.

Dampness is conceded to be the greatest enemy of the health of chickens. Soil out doors is always damp. Plants could not grow if it were not. Disease germs or bacteria are plants and thrive in damp media. Absolute dryness stops their growth and sufficient heat destroys them.

The suggestion of the chicken factory will be sweepingly condemned by many poultrymen on the grounds that it is an extreme case of intensive poultry culture. Yet it absolutely eliminates the chief cause of the failure of intensive poultry rearing, which is soil contamination or the gradual increase in the soil of the various known and unknown forms of disease, germs and parasites.

The chicken factory with no surface exposed but dry smooth steel, and a circulating and frequently cleaned and sterilized litter, has no problem of soil contamination, and forms a more sanitary environment than any possible outdoor poultry farm. To be sure, there is no sunshine with its supposed germ-killing powers, but sunshine, though a great popular health giver, is rarely called into use as a sterilizing agent in industrial problems. There are cheaper and better ways to gain the same effect.

The following are the usual pleasure-giving occupations of vigorous outdoor chicks:

(1) Walking or running to and fro between locations possessing attractions. (2) Walking (slowly) in search of food. (3) Scratching in search of food. (4) Chasing live prey. (5) Chasing other chicks that have picked up morsels of food

LEGAL NOTICES

INQUIRIES

Inquiry No. 9445. Wanted the name and address of a manufacturer who can make a combination pencil holder and point protector.

Inquiry No. 9446. Wanted the name and address of a manufacturer who can supply machinery for automatically wrapping cigars in thin imported tissue paper having the ends tightly wound and curled. Would consider purchase of machines or patent rights.

Inquiry No. 9447. Wanted to buy patented article, which is needed in every home, with a possible view to manufacturing and distributing.

Inquiry No. 9448. Wanted to get in touch with manufacturers who can make small gasoline motors and parts thereof. Must be able to handle considerable orders with expedition.

Inquiry No. 9449. Wanted the name and address of a manufacturer who is prepared to build a new and very simple stationary engine with or without gas producer.

Inquiry No. 9450. Wanted the name and address of a manufacturer who can build a light simple motor for light automobiles and for portable farm work.

Inquiry No. 9451. Wanted the name and address of a manufacturer of machinery for making egg albumen.

Inquiry No. 9452. Wanted the name and address of a manufacturer making machinery for the production of Tannic Acid from the Mangrove plant.

Inquiry No. 9453. Wanted the name and address of a maker of a machine for washing and drying bristles; also machine for cutting, combing and assorting bristles.

too large to swallow at once. (6) Bathing or wallowing in dust. (7) Fighting.

In the indoor plant the distance to be traveled daily can be increased by placing such "utilities" as the water drip and dust bath well apart.

A wholly artificial stimulant to travel may be secured by a system of light sequences after the manner of the sign flasher. The chicken will follow the light and could be run into exhaustion by such an elusive chase. However, it is the joy-giving occupations rather than the fear of darkness on which we should depend for inducements to exercise.

Chief among the latter group is scratching. The feeding of cracked grain in litter is standard practice in poultry husbandry to-day. The poultryman scatters grain in the litter and mixes it with his feet or some hand tool. The more often this is done the more exercise the chickens take and the greater the consequent vitality. But the human labor is irksome and is rarely performed more than once or twice a day. The strong chicks rush in and gobble up the cream of the pickings and the weaker chicks do not get enough either of food or exercise.

In the chicken factory the scratch feed and litter may be thoroughly mixed by machinery and carried by a light mechanical conveyor over the top of the scratch floors, and, with the aid of gravity, distributed to the floors below. If a slight pitch is given to the floor, the scratching action of the chicks will result in the litter working laterally across the floor area and falling through a grating on the opposite edge. I have tested out this principle in various forms and can state with certainty that the method is entirely practical. If the floors are properly constructed they do not become bare in any part, hence no dung adheres to them. The circulating litter carries away all dropping. The floors are thus self-cleaning.

The spent litter falls into gutters, from which it is gathered by carriers and blown through a heated chamber, where it is thoroughly dried, and where it may be heated to a sterilizing temperature, if this is deemed advisable. After drying, the litter is separated (by air separation combined with bolting) into the component parts of dust, dung, clean litter and residual feed. The last two items, with fresh additions, are recirculated. The frequency of the complete circulation is determined by the depth of the litter on the chick floors, and that again is dependent on the design of the floors.

Litter feeding is essential, but as an exclusive system it has two shortcomings. One is that many foods, such as mill by-products, or meat and milk products, cannot be fed in the litter because they are in a powdered form. A second objection against the exclusive feeding in litter is that chickens will not eat enough to force rapid growth or high egg yields. On the other hand, when chicks are given wet dough or mash from troughs they fail to take sufficient exercise.

My first effort to overcome this dilemma and to eliminate the labor of hand feeding of mash was by the making of "artificial worms." These were formed by forcing the mash mixture through a perforated plate. By breaking up the spaghetti-like dried product I secured a food containing the ingredients of the mash and suitable to be fed dry in the litter.

With a view of making this product as appetizing as possible a variety of flavors, colors and shapes were tried, but without making consequential discoveries. What I did find out was that after having eaten its fill of dry grain or dried "worms" the chick could be tempted to further indulgence by the offer of soft dough worms fresh from the press.

As a result of this discovery, we rigged a worm press with but a single aperture and inserted this into the chick pan at a point above the chick's head. The result was comical. Between the jumping for the worms at the nozzle and the chasing and tussling over those already captured, that flock of chickens were busier than ever indoor chickens were in the history of hendom.

We had found a way to feed soft food

without putting a premium on inactivity. The problems of mechanics and sanitation involved in such a system are too difficult to render the idea practical for the small chicken grower, but in the large chicken factory this principle should find practical application.

The list of chicken entertainments is completed by the dust wallow and grain-sprouting trays, where the chicks may pick off the grain as it grows up through a wire cloth grating.

By such means the sum total of activities of the indoor chick can be made to equal that of his free range cousin, and to far excel those of the brooder-house or yarded chicken.

Water is provided by vertical drips, the chick drinking from a vertical trickle of water. There is no exposed cavity or receptacle to catch dirt. The pipes and drips may be sterilized by flushing with a disinfectant while the chicks are asleep. The installation of this water system does not cost half a cent a chicken, and the item of watering would drop off the labor calendar.

Many other laborious tasks of outdoor poultry farming may be entirely eliminated. The automatic litter sterilization replaces the usual tasks of disinfecting and spraying for lice. Outdoor varmints need not be reckoned with, and the concrete building will not harbor rats. No time will be wasted in getting chicks in from storms or nursing them because of the effects of wetting and chills. Practically the only hand labor operations remaining in the daily routine in the chicken factory is the renewal of electric light bulbs and the removal of chicks that die.

The application of the methods of the modern factory to the production of the higher forms of animal life is something for which no precedent is set. The actual technical problems involved are not more difficult than those of many chemical and engineering enterprises, but the husbandry of animal life is a phase of industry where ignorance is still personified and glorified as the great god Nature, and where the memory of hens singing in the haymow sways human judgment more than the findings of science.

Had there been but a single advantage or economy involved, the writer would doubtless have long since given up his efforts, but the project brings together an array of both biological and commercial economies that serve to keep the light of faith aburn amid many difficulties. Here is a list as they appear to me:

Commercial Economies.

Economies of large business operations in buying and selling.

Economies of large plant operations, as the saving and building cost, heat, power, etc.

The substitution of machine for hand labor.

The lengthening of the working time of the plant in both the daily and yearly cycles.

A location that automatically eliminates four out of five of the middlemen who now intrude between the poultry producer and consumer.

A location where the consumer may see the goods produced and be convinced that he is getting a fresh article.

The extra value of a standardized product of constant quality.

Biological Economies.

Controlled temperatures for the fowls at all times.

Ample pure air, thoroughly distributed.

Freedom from winds or drafts.

Freedom from dampness.

No contact with disease-breeding soil.

Clean, dry, sterile, scratching litter.

No wood, cloth or other combustible or unsanitary fixtures.

A variety of joy-giving occupations and exercises.

An automatic, sanitary water system.

Controlled feeding at all times for all chicks.

Absence of long winter-night fasts.

More total hours of sleep (for baby chicks).

No losses from vermin, varmints or chicken thieves.

Cadillac
Standard of the World

You must surely realize, now, that the Cadillac dominates the quality class "by right of conquest."

Time was when it was surrounded by clamorous contenders for a share of Cadillac success.

Of all these ambitious aspirants, not one remains—they have all descended into a lower price-class.

The Cadillac has maintained its price and at the same time has held the loyalty and allegiance of an intelligent following which has steadily grown larger as the years advanced.

It has maintained its own class, and drawn from all classes—attracting by its inimitable performance, those who have paid much more than the Cadillac price, and those who have paid less.

The time is at hand for the complete fulfillment of the ideal upon which this business was built.

That ideal was the production of a car of the highest quality, at a price more moderate than any then known.

We said, then, that we would demonstrate that it was not necessary to pay more for such a car than the Cadillac would ask.

Ask yourself if the Cadillac "Eight" has not brought about the consummation of that ideal?

How many cars remain which you would willingly and instinctively consider worthy of comparison with the new Cadillac Eight?

It is firmly established in the esteem of the nation as the highest known type of quality.

In the number of parts and operations refined to an accuracy of one-thousandth and the half of one-thousandth of an inch, it is accepted as the world's standard.

Its engineering pre-eminence is universally conceded.

It is the one car in the world which has *demonstrated* the efficiency and stability of its V-type engine to the satisfaction of more than 15,000 users.

In the opinion of tens of thousands of discriminating motorists, it represents the very uttermost in steadiness, in smoothness and quietness—the very uttermost in efficiency at high speed or low speed—the very uttermost in everything that constitutes luxurious motoring.

In announcing its purpose years ago, this Company said that the Cadillac would create a new standard of automobile values.

The very phrase itself has passed into automobile English and become a part of the language of the industry.

But the Cadillac has translated the phrase into practise and made it come true in the most literal sense of the word.

The Cadillac is in very fact the standard of the world.

Styles and Prices

Standard Seven passenger car, Five passenger Salon and Roadster, $2080. Three passenger Victoria, $2400. Five passenger Brougham, $2950. Seven passenger Limousine, $3450. Berlin, $3600. Prices include standard equipment, F. O. B. Detroit.

Cadillac Motor Car Co. Detroit, Mich.